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ABSTRACT

Authorized by the California Department of Education, this report provides an analysis of research-based guidelines for the educational applications of technology and information resources and the communication and learning opportunities made possible by telecommunications. The report specifically addresses current state-of-the art technologies and potential future developments for network resources, as well as how to provide staff development and technical assistance for teachers to integrate these resources into the curriculum. It is based on a comprehensive evaluation of the "Telemation" project, a statewide effort begun in 1993 to equip educators and administrators with the skills and knowledge necessary to successfully use telecommunications in support of teaching and learning. The questions answered by this report focus on: (1) educational technology as a priority; (2) importance of research; (3) impact on teaching and learning; (4) relevance to education reforms; (5) educational telecommunications policy; (6) access and applications; (7) planning and instructional integration; (8) staff development and technical assistance; (9) classroom applications and examples; (10) recommendations for instructional application; (11) recommendations for state and national policy; and (12) resources for instruction and policy. Appendices include: Telemation evaluation executive summary; glossary; examples of people using computer networking for learning; participants in the FWL (Far West Laboratory) survey of staff development and technology; a World Wide Web "hotlist" for educators; and additional reading materials. (Contains 61 references.) (AEF)

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TELECOMMUNICATIONS TECHNOLOGY AND EDUCATION

WHAT HAVE WE LEARNED FROM RESEARCH AND EXPERIENCE?

PREPARED BY
JOHN CRADLER
ELIZABETH BRIDGFORTH
FAR WEST LABORATORY

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FOR THE
CALIFORNIA DEPARTMENT OF EDUCATION
AND THE TELEMATION PROJECT

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PURPOSE 1
I. EDUCATIONAL TECHNOLOGY AS A PRIORITY 3
A. National Perspective 3
B. Federal Initiatives 4
C. State Initiatives 5
D. Summary 6
II. IMPORTANCE OF RESEARCH 7
A. National Perspective 7
B. Educational Technology and Telecommunications Research Issues 7
III. IMPACT ON TEACHING AND LEARNING 9
A. National Perspective 9
B. Research Findings 9
C. Summary 13
IV. RELEVANCE TO EDUCATION REFORM 15
A. National Prospective 15
B. Linking Education Reforms and Technology 15
C. Preliminary Research Findings 16
D. Learning Reform Enhanced by and Supportive of Technology 19
E. Technology Facilitates Transformations in Thinking and Working 20
F. Summary 20
V. EDUCATIONAL TELECOMMUNICATIONS POLICY 23
A. National Perspective 23
B. NCC-TET Requirements for Education and the NII 23
C. The Council of Chief State School Officers Telecommunications Policy Report 24
D. U.S. Department of Commerce Guidelines 25
E. Summary 25
VI. ACCESS AND APPLICATIONS 27
A. National Perspective 27
B. Current Reality Regarding Access and Use of Technology in Schools 28
C. Access Goes Beyond Connectivity 29
D. Access to Needed Time, Support and Training 30
E. Guidelines for Increasing Access to the NII 31
F. Summary 31
VII. PLANNING AND INSTRUCTIONAL INTEGRATION 33
A. National Perspective 33
B. A Research-based Approach to Effective Planning for Technology Integration 33
C. Developing a School and Classroom-level Plan 35
D. Summary 39
VIII. STAFF DEVELOPMENT AND TECHNICAL ASSISTANCE 41
A. National Perspective 41
B. Input on Staff Development to the National Educational Technology Plan 42
C. Current Status of Teachers and Staff Development for Technology Use 43
D. Barriers to Staff Development 44
E. Some Promising Approaches for Staff Development and Technology Implementation 45
F. The Need for Follow-up Technical Assistance 45

G. Telecommunications and Professional Development 46
H. Staff Development Guidelines Applied to Technology Use 47
I. A Flexible Model for Training and User Support 48
J. What the Experts Have to Say About Staff Development and Technology Integration 49
K. Involving Administrators in Staff Development 53
L. Overview of Teacher Support Factors for Effective Technology Integration 54
M. Summary 55

IX. CLASSROOM APPLICATIONS AND EXAMPLES 57
A. Bringing New Resources into the Classroom 57
B. Studies on Barriers to Using Technology in the Classroom 58
C. Local Implementation of Telecommunications 58
D. Using Computer Networking for Learning 60
E. Model Schools as a Resource 62
F. Specific Applications of Telecommunications Supporting Reform 64
G. Summary 65

X. RECOMMENDATIONS FOR EDUCATIONAL APPLICATION OF TELECOMMUNICATIONS 67
A. National Perspective 67
B. OTA Conclusions about what is Necessary to Implement Technology and Telecommunications in Education 68
C. Recommendations from the Council for Educational Development and Research 69

XI. Recommendations for State and National Policy 71
A. National Perspective 71
B. National Actions To Promote Education Access to the NII 72
C. Possible State Actions to Help Implement an Education Agenda for the NII 73
D. Considerations for an Expanded R&D Agenda for Educational Technology 73
E. Input to the National On-line Conference on the Federal Role in Promoting Technology for the Professional Development of Teachers 74

XII. Resources for Instruction and Policy Development 77
Planning 78
Goals 2000, Educational Reform, and Technology 77
Curriculum Resources Related to Technology 78
Policy Reports 79
Distance Learning and Instructional Television 80
Computer Software, videotapes, and multimedia 80
Support Resource Agencies 81
Professional Organizations 83
Business Partnerships 84
Internet Resources 84
Telecommunications and the National Information Infrastructure 86
Research and Evaluation Studies, Reports, and Guidebooks 87
Funding Guides 89
Student Information Resources 89
Journals, Magazines, and Newsletters 90

APPENDICES 95

TELECOMMUNICATIONS AND EDUCATION:
WHAT HAVE WE LEARNED FROM RESEARCH AND EXPERIENCE?

PURPOSE

This report provides an analysis of research-based guidelines for the educational applications of technology and information resources and the unique communication and learning opportunities made possible by telecommunications and makes recommendations for the instructional use of networking technologies and resources. The report specifically addresses current state-of-the art technologies and potential future developments for network resources and how to provide staff development and technical assistance for teachers to effectively integrate these resources into curriculum and instruction. For information about technical networking issues, many publications, such as the California Department of Education Publication, *Building the Future: K-12 Network Technology Planning Guide* (1994), can be a further source of information and guidance.

This report, *Telecommunications and Education: What have we learned from research and experience,* was authorized by the California Department of Education as an effort to better define the educational applications of telecommunications. As this report was being developed, the research findings were shared with Telemation Project staff and Telementors to help inform project development and training institute content. This report will help guide California in designing and implementing staff development strategies and provide direction for teachers in their use of telecommunications as an instructional resource. The questions to be answered by this report are:

I. **Educational Technology as a Priority.** What is the current level of interest on the national and state levels in promoting the infusion of technology into education?

II. **Importance of Research.** Is it still necessary to study the educational applications of technology and telecommunications and the impact on teaching and learning?

III. **Impact on Teaching and Learning.** What does research and experience tell us about the benefits and the most appropriate uses of technology and telecommunications to support and expand teaching and learning?

IV. **Relevance to Education Reforms.** How will the integration of technology and telecommunications support educational reform efforts from the state to the classroom level?

V. **Educational Telecommunications Policy.** What is the range of policy issues related to the use of telecommunications in education?

VI. **Access and applications.** What is the current situation with respect to teacher and student access to telecommunications and relevant content on the network?

VII. **Planning and Instructional Integration.** What does experience and research have to suggest about planning for the effective integration of telecommunications into curriculum and instruction?

VIII. **Staff Development and Technical Assistance.** What are the most effective staff development strategies and how do these apply to building the capacity of teachers to effectively integrate telecommunications and technology into teaching?

IX. **Classroom Applications and Examples.** What are some examples of the most effective uses of telecommunications and the resources accessed for teaching and learning?

X. **Recommendations for Instructional Application.** What does experience and research suggest for the effective use of technology and telecommunications to support instruction and enhanced learning?

XI. **Recommendations for state and national Policy.** What does the information about telecommunications and technology use suggest for state and national policy?

XII. **Resources for Instruction and Policy.** What are the most useful resources to assist educators and policy-makers in planning and utilizing technology and telecommunications to support teaching and learning?

The approach to this study in answering the above questions was to conduct a comprehensive review of existing research and evaluation studies, as well as information gathered from surveys and interviews of persons acknowledged as leaders in electronic networking for education. Major sources for this report include the recent OTA study, *Teachers and Technology*, the FARNET - CoSN Forum results, *Building Consensus, Building Models: A Networking Strategy for Change*, a review of literature on technology and telecommunications use in education, and a variety of educational technology resource documents, as well as a thorough search of relevant Internet resources. Additionally, the National Coordinating Committee for Technology Education and Training (NCC-TET) developed nineteen requirements to ensure that the National Information Infrastructure (NII) would provide expanded opportunities for education. These requirements represent the consensus of over 85 education, business, and governmental agencies in the nation. Where appropriate the NCC-TET requirements and the rationales will be provided as background for the question addressed.

The findings are related to the results of the evaluation of the Telemation Project -- a project designed to systematically provide training and support to build the capacity of teachers to effectively apply the use of telecommunications to support teaching and learning.

I. EDUCATIONAL TECHNOLOGY AS A PRIORITY

What is the current level of interest on the national and state level in promoting the infusion of technology into education?

A. National Perspective

In this era of a global marketplace, when information technology has revolutionized the way business, higher education, and governments communicate, schools still rely for the most part on traditional methods of teaching and learning inherited from the industrial age. Teachers, it is often remarked, are the only professionals who do not even have telephones on their desks (Breeden, et al, 1994). Many leaders at the state and national level are making similar observations about the nation's schools. The view expressed is that one of the most important issues facing the nation and the states is to determine ways to enable schools and communities to better prepare students for a technological workforce and ensure that education has a place on the National Information Infrastructure (NII). In taking advantage of the NII, it is critical that educators pay attention to research and experience make optimal use of this resource.

In the 1994 address on the State of the Union President Bill Clinton said:

> *We must work with the private sector to connect every classroom and library to a national information superhighway by the year 2000.*

Speaker of the House Newt Gingrich recently stated that all students should have access to the Internet and that all persons should possess a laptop computer. Additionally, FCC Chair Reed Hundt pointed out that:

> *There are thousands of buildings in this country with millions of people in them who have no telephones, no cable television and no reasonable prospect of broad band services. They're called schools.*

Expressing the importance of the information highway for education, Reed Hundt went on to state:

> *We have entered the high technology information and communication age -- the age of the national information superhighway. The NII will consist of thousands of interconnected, interoperable telecommunications networks, computer systems, televisions, fax machines, telephones, and other "information appliances". In the future the NII will enable all Americans to get the information they need, when they need it, and where they need it, for an affordable price.*

Most industries already use information technologies and networks, and most jobs either require employees to be proficient in technology applications or at least have enough knowledge about technology to be able to determine its application. Currently, schools are not preparing citizens for the technological age; schools *must* simultaneously progress with industry to ensure that American citizens are prepared to meet the technological challenges of the 21st Century. Network-based projects can teach learners critical information-age skills that they will need as part of the 21st Century workforce; collecting, organizing, analyzing, evaluating, communicating all types of information, and using computers and other advanced technology.

The Department of Labor's Secretary's Commission on Achieving Necessary Skills (SCANS) found that, "Good jobs depend on people who can put knowledge to work" (Department of Labor, 1991 - from FARNET-CoSN, 1993). However, when looking to schools to prepare the future workforce, David Britt, President of Children's Television Workshop observes:

> *The coming levels of interactive technology hold the potential to create order-of-magnitude changes in the productivity of American education.....[but] schools today are one of the few workplaces in our society that our grandparents could recognize easily....*

In *The National Information Infrastructure: Agenda for Action,* the Clinton Administration promises that the best schools, teachers, and courses will be available to all students, without regard to geography, distance, resources, or disability. Vice President Gore promoted the Administration's agenda at a California Summit, where he highlighted the importance of education's involvement in the NII. He then visited Monta Vista High School in Cupertino, to observe and interact with students using the Internet to conduct projects. What follows is an update of the federal and state interest in linking schools to the NII with some suggestions about how to proceed in this effort.

B. Federal Initiatives

Federal Legislation Promotes Technology in Education. To put policy into action, the Administration and the Congress offered a national vision and strategy "to infuse technology and technology planning into all educational programs and training functions carried out within school systems at the state and local level." Principal components of both the *Goals 2000 Educate America Act* and the *Improving Americas Schools Act* (IASA) are to promote the use of technology to enable all students to achieve the National Education Goals.

THE EIGHT NATIONAL EDUCATION GOALS	
Goal 1.	All children in America will start school ready to learn.
Goal 2.	The high school graduation rate will increase to at least 90 percent.
Goal 3.	American students will leave grades 4, 8, and 12 with demonstrated competence in challenging subject matter.
Goal 4.	Teachers will have access to professional development needed to instruct students for the next century.
Goal 5.	U.S. students will be first in the world in math and science achievement.
Goal 6.	All Americans will be literate and have the knowledge and skills necessary to compete in a global economy and exercise citizenship rights and responsibilities.
Goal 7.	All schools in America will be free of drugs and violence and offer a disciplined environment.
Goal 8.	Every school will promote partnerships to increase parental involvement in fostering social, emotional, and academic growth of children.

Goals 2000 provides national leadership through the establishment of the Office of Educational Technology within the U.S Department of Education. This Office is developing a long-range national educational technology plan. Additionally, the Improving Americas Schools Act has authorized programs such as the Technology Challenge Grants and the Regional Technology Assistance Consortia to provide local and regional access and assistance for educational technology. These programs will increase state and local educational technology development efforts and provide additional staff development and technology resources to California schools through the NII. In addition, the state and the California Technology Project Regional Affiliates (soon to be called the California Technology Assistance Project - CTAP), will have an increased

capacity to support schools in the integration of educational technology. Additionally, schools are encouraged to utilize funding through the new IASA Title I programs, Goals 2000 sub-grants, and other federal programs to further implement technology. Details on funding from these programs can be found on the U.S. Department of Education Internet site (see Resource section of this document).

C. State Initiatives

In California, there has been increased interest in making technology a major priority for education. Policy-makers recognize that in recent years California has moved from ranking in the top 10 to 50th in comparison to other states in the ratio of computers to students . Realizing that less than 2% of teachers have access to or utilize telecommunications has prompted action to connect California schools the NII.

Superintendent of Public Instruction Delaine Eastin recently stated that. . .

> *. . . .the cost just to bring California to an "average" level in technology applications is in the billions of dollars. Of course, we want do better than average, but we can't do it alone. We need help from business and industry. The future of California is at stake. If we fail to do this -- if our graduates are ignorant of the many new technologies -- private businesses will have to acquire their work force from other states, or will move out of the state altogether, and the statistics on California's unemployed will continue to spiral upward (CUE, 1995).*

The California Teachers Association issued a report, *Rediscovering Education: Creating Schools for the 21st Century.* One of the five recommendations is that schools must be provided the necessary resources to obtain, maintain, and regularly upgrade the hardware and software required to employ state-of-the-art technology. The report also states that a bold and comprehensive program to bring the advantages of technology into the classroom is fundamental to creating schools for the 21st Century.

Mobilizing for Competitiveness: Linking Education and Training to Jobs, A Call for Action from The California Business Roundtable, recommends the integration of technology into curriculum and instruction throughout K-12 education and community colleges. The report states that "despite substantial investments over the last decade, technology remains an underutilized 'add on' in most schools," and asserts that "barriers to the full integration of technology into education include inadequate resources with substantial capital investment needed to purchase essential equipment in adequate quantities," and that teachers do not know how to use technology to enhance learning. The report recommends full funding of the *California Master Plan for Educational Technology.*

The California Public Utilities Commission (CPUC) released a report, endorsed by the Governor, that outlines a strategy to allocate $150 million to connect and provide staff development for K-12 education to access and utilize telecommunications. Senator Hershel Rosenthal introduced legislation (SB 1960) to implement these recommendations. Following the CPUC announcement, Pacific Bell announced *Education First,* an initiative to connect all schools to the infrastructure with two free telecommunications connections to two classrooms per school, with one year of free monthly service to use these connections. GTE and other companies are following with similar plans.

The California legislature has introduced several bills that would authorize the use of funds collected by the CPUC to connect libraries and K-12 classrooms to the NII. Most of these bills

are still awaiting final action. Viewing telecommunications and technology as a priority, the Governor set aside $10 million in the state budget for schools to purchase technology, with priority given to the purchase of recycled computers, and allocated over $250 million on a one-time basis, which schools can use to purchase such items as computers and instructional materials. This would augment the current $13.6 million that funds the implementation of current programs in the state. For a discussion of California's educational technology programs funded from 1984 to 1994, see the article in the June/July, 1994 edition of *Thrust for Educational Leadership*.

In the Summer of 1995, a report from the Governor's Council on Information Technology, *Getting Results*, calls on California's schools and post-secondary institutions to:

> *Establish a "results-oriented" approach for the use of information technologies and allocate education funding for the broad deployment of information technology for the following purposes:*
>
> - Enable students to learn the basics
> - Ensure that students acquire the ability to use technology to create, store, find, and transmit information, and develop the ability to analyze information critically
> - Enhance the learning environment, customize learning to students' abilities, and provide expanded choices of courses
> - Share expertise and teaching resources between campuses and systems
> - Promote parental involvement in education via e-mail and voice mail
> - Reduce administrative burdens on teachers that detract from their opportunities to teach

The report recommends that by the Fall of 1997, new teachers may be certified only if they have met rigorous new standards for competency in computer-based applications and effective use in the classroom, and a plan should be implemented for in-service training of current teachers to meet these standards.

D. Summary

This section reviews the level of importance that government and policy leaders are placing on technology and telecommunications for education as a national and state priority. The overview points out the rapidly emerging interest of policy-makers in making technology an essential component in education. Examples discussed are the integration of technology into state Goals 2000 Educational Improvement Plans, the President and Vice President promoting education and the NII, and various California initiatives, such as the Governor's report on technology in schools, state funding for computers in schools, and the interest of other stakeholders, such as the CPUC, CTA, and the California Business Roundtable. It is important for those who develop policy and design and implement technology to be aware of what has already been learned from the experiences of educators and of researchers. These lessons and findings must be considered when developing and implementing programs and funding options to increase access and effective use of emerging technologies in California's classrooms.

In addition to policy-makers' awareness of research, of importance for all educators, business leaders, and others interested in educational technology is to be aware of the emerging interest on the part of the state and federal government in technology. This interest strongly suggests that educators should be ready to share the benefits and findings of technology initiatives and research efforts with state and national political leadership. This information is necessary to make technology in education a priority for future potential state and federal funding.

II. IMPORTANCE OF RESEARCH

Is it still necessary to study the educational applications of technology and telecommunications and the impact on teaching and learning?

A. National Perspective

Educators need access to research findings for guidance in the selection of hardware and educational software. In numerous instances, school districts have made major technology purchases without reliable information about the educational benefits of these resources. Further research is needed to guide the development of new software and to determine the ability of existing technologies to meet the challenges found in education and training environments. The federal government should support and encourage the study of technology and its applications in various circumstances for specific populations. Research findings should be made available to all educators over the NII. To meet this need the NCC-TET established a requirement which states that the implementers of the NII must: *Conduct research on the education and training applications of current and emerging technologies. (NCC-TET, 1994).*

The importance of research is also emphasized in Governor Wilson's report by Information Technology Council member, Ron Fortune.

> *When looking at educational software, ask 'So what? Is it useful? Does it help kids learn what they need to learn?*

In its report the Council states that education must build on the new knowledge we have about how people learn. Research has shown that students learn best in a learning environment that is student-centered rather than teacher-centered, and technology can support student-centered learning both effectively and affordably. By allowing students to learn in the way that is best for them, at a pace that is best for them, technology can provide a learning environment where every student can be a successful learner (*Getting Results*, 1995).

B. Educational Technology and Telecommunications Research Issues

It is becoming evident that although educators may have access to technology and telecommunications, educationally relevant resources are difficult to find and even more difficult to integrate into state and local education standards and into daily instruction. While network browsers and search engines alleviate some of the difficulties of locating resources, teachers still need the time to sort through the abundance of information, assistance in determining the quality of resources, and training for the effective use of these resources in the classroom.

Some of the common issues that must be addressed in the emerging use of technology in education are expressed in a recent book by Clifford Stoll, *Silicon Snake Oil: Second Thoughts on the Information Highway* (1995), in which Stoll poses the following questions:

- Does the Internet provide access to learning materials that are better than those already found in printed materials?
- Because of reduced social interaction, will a generation of network surfers lose touch with the world around them?

- Will students be wasting time by being side-tracked in exploring the network?
- How will the content be regulated to prevent students from spending their study periods scanning inappropriate material?
- Do we know what kids are really learning when they use the network?

Stoll is a well known skeptic who believes that no phenomenon in modern times has received more attention, held out more promise, nor achieved more mythic stature than the information highway. For example, he contends:

- Computers are tough to teach with.
- The computer is a barrier to close teaching relationships.
- Technology is not a substitute for studying under a "fired-up" teacher who's there in person.
- Computer networks isolate us from our friends and neighbors.
- The network world is a passive, pre-programmed place, where one click on the mouse gets the right answer.

For those involved in using the Internet and other technologies in education, it is important to keep these and other issues in mind. It is research and experience, some of which is discussed in the following pages, that will help educators to address these and other issues and make the most appropriate and effective use of technology and telecommunications ins teaching and learning.

III. IMPACT ON TEACHING AND LEARNING

What does research and experience tell us about the benefits and the most appropriate uses of technology and telecommunications to support and expand teaching and learning?

A. National Perspective

In a 1993 forum sponsored by the Federation of American Research Networks (FARNet) and the Consortium for School Networking (CoSN), more than 70 educational decision-makers and practitioners from across the country and from all levels of the educational system participated in on-line discussions and then met for two days to prioritize benefits and issues related to educational networking. Forum participants concluded that networking technology is a powerful communications tool with the potential to facilitate educational reform. Properly implemented and supported, this tool can empower and excite students and teachers, while capturing the imagination of the community. Utilizing networking technologies in the classroom can encourage active learning, support innovative teaching, help relieve the professional isolation of teachers, and enable users to become active researchers and learners.

Network technology can also support site-based management by opening new lines of communication with outside information sources and by improving internal channels of communication among various decision-making levels. Many of the reports on the benefits of technology are derived from consensus statements from forums such as this.

B. Research Findings

This section summarizes major research findings from over 100 studies reviewed by Far West Laboratory, Software Publishers Association, Apple Computer Inc., the Office of Technology Assessment, the Monterey Model Technology Schools Project, and other sources as indicated.

The Office of Educational Research and Improvement (OERI) has funded numerous studies and projects that have documented the specific benefits technology can afford to education. These studies provide ongoing feedback to developers of technology-based programming to ensure alignment with high academic standards and interesting programming to meet the needs of diverse learning populations. The research also provides information needed by policy-makers, legislators, and educators in the development of legislation and state and local plans for the integration of technology into schools. Following are specific findings recently reported.

1. Student outcomes: The effectiveness of technology tends to vary as a function of the curriculum content and instructional strategy delivered by the technology. When content and strategies are determined to meet accepted education standards, research documents that technology can be a benefit. A recent review by Far West Laboratory (1994) of current research and evaluation findings from various studies has determined that the integration of technology and telecommunications into education:

- Increases performance when interactivity is prominent
- Increases opportunities for interactivity with instructional programs
- Is more effective with multiple technologies (video, computer, telecommunications etc.)
- Improves attitude and confidence -- especially for 'at risk' students

- Provides instructional opportunities otherwise not available
- Can increase opportunities for student-constructed learning
- Increases student collaboration on projects
- Increases mastery of vocational and work force skills
- Helps prepare students for work when emphasized as a problem solving tool
- Significantly improves student problem solving skills
- Improves writing skills and attitudes about writing for urban LEP students
- Improves writing skills as a result of using telecommunications
- Increases the preparation of students for most careers and vocations

A national survey by the Center for Technology in Education regarding telecommunications and K-12 educators (Honey, 1993) found that:

- Science, social awareness, and cultural exchange projects are perceived to be the most effective telecommunications activities to do with students.
- News services and scientific databases are rated as the most useful information retrieval activities for use with students.
- The most highly rated incentives for using telecommunications with students included expanded students' awareness about the world, accessing information that would otherwise be difficult to obtain, and increasing students' inquiry-based and analytical skills.
- The key factors that influence the success of non-technology-based shared learning activities also influence activities mediated by telecommunications. These are planning, cooperation, and well-defined and relevant project goals.

The Office of Technology Assessment (OTA) conducted a comprehensive nation-wide assessment at the request of the Senate and House Committees on Education and Labor. The study showed that **with adequate teacher preparation** technology greatly facilitates:

- Teaching of abstract concepts and problem solving, as well as basic skills
- Independent work, teamwork and collaborative inquiry
- Adaptation of instruction to accommodate student learning styles and special needs
- Higher expectations of students and presentation of more complex materials
- Less teacher lecture, with more student-centered classrooms
- Opportunities for new learning experiences (OTA, 1995)

2. Educator outcomes: Research on technology's benefits for teaching is generally positive, with a shift from the traditional direct approaches to a more student-centered approach. Research specifically shows that educator-use of technology results in:

- Increased emphasis on individualized instruction
- More time engaged by teachers advising students
- Increased interest in teaching
- Interest in experimenting with emerging technology
- Increased administrator and teacher productivity

- Increased planning and collaboration with colleagues
- Rethinking and revision of curriculum and instructional strategies
- Greater participation in school and district restructuring efforts
- Increased teacher and administrator communication with parents
- Increased communications among teachers (OTA, 1995)

The national survey of telecommunications and K-12 educators by the Center for Technology in Education, (Honey, 1993) found that:

- More than two thirds of the educators surveyed report that integrating telecommunications into their teaching has made a real difference in how they teach.
- Conducting telecommunications activities with students enables teachers to spend more time with individual students, less time lecturing to the whole class, and allows students to carry out more independent work.

3. Conditions for technology to be effective. The findings of these and other studies generally and consistently show that technology alone does not have a significant effect on teaching and learning. Technology is a tool that when used with tested instructional practices and curriculum can be an effective catalyst for education reform (Cradler, 1992). The following are the major factors necessary to support the effective application of technology to learning:

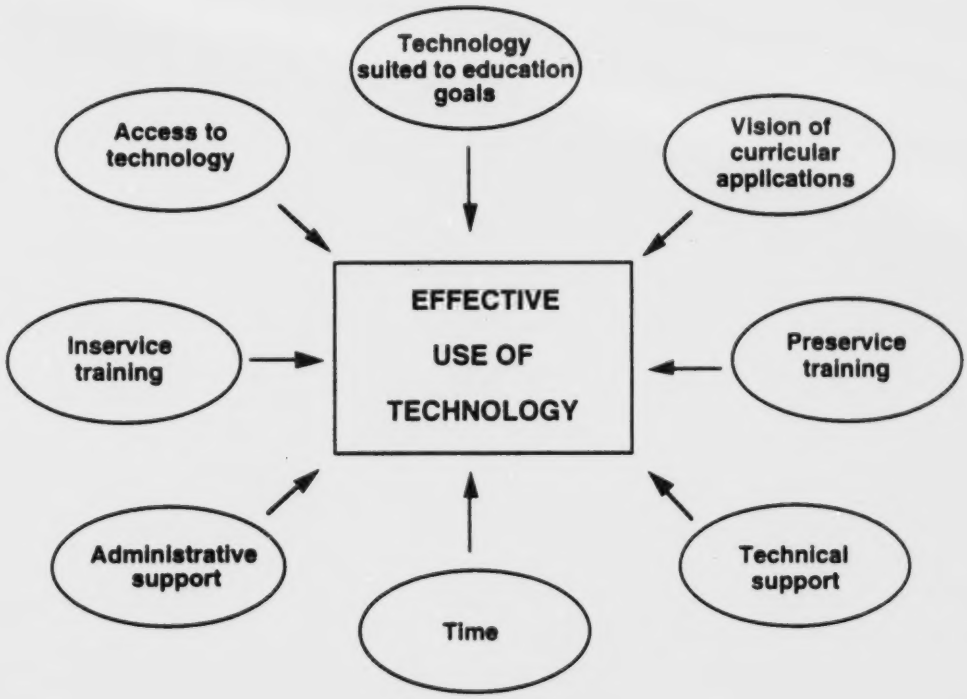
- Staff development that is individualized to the needs of the teacher
- Technical assistance that is available when needed
- Time for teachers to plan, learn about, and implement technology applications
- Long term staff development to support the integration of technology into instruction
- Understanding of ways to integrate technology into education reform
- Teacher-access to technology while planning
- Involvement of teachers in planning statewide, school, and classroom uses of technology

The Far West Laboratory study of the impact of educational technologies from 1984 to 1991, and research on the California Model Technology School Projects show that technology alone does not have a significant effect on teaching and learning unless certain conditions exist, such as the following:

- Teachers must integrate technology and telecommunications applications into the ongoing program.
- Technology and networking should offer opportunities for students to solve problems and construct solutions.
- Technology must give students more control over learning while teachers serve as facilitators.
- Teachers and administrators must jointly plan for the use of technology and networking.
- Government must promote educationally sound applications of technology and development of software and video programs that meet educational content standards.
- Telecommunications is especially effective when combined with other technologies and linked to high education standards.
- Student access to telecommunications increases opportunities and incentives for students to construct and invent their own learning

The OTA suggests minimum requirements for the effective use of technology in education, as indicated in the following list and chart.

- Suiting technology to education goals and standards
- Having a vision for the use of technology to support curriculum
- Providing for both inservice and preservice training
- Ensuring access to appropriate technology
- Providing for administrative support for technology use
- Providing time for teachers to plan and learn how to integrate technology
- Providing for ongoing technical support for technology use



4. Features of effective learning technologies. Research on teaching and learning identifies critical features of technology-based resources for effective applications in education. Developers of educational technology programming should make efforts to incorporate the following elements into programs:

- Immediate adjustment of task difficulty in relation to student responses
- Instant feedback on correctness of responses
- Ease of use by students and teachers
- Sustained interest and use by students
- Simulations of tasks not possible in the classroom or from books
- Student control of pacing the educational programming

- Opportunities for individualized problem solving
- Opportunities to use multiple technologies
- Built-in assessments and procedures to matched technology resources with learner needs
- Field testing of technology-based resources with a variety of students in a variety of settings
- Teacher involvement in the development of educational technology programs
- Alignment with curriculum frameworks and/or existing instructional resources

5. State and federal program support factors: A survey of the research and review of 20 state plans, conducted by Far West Laboratory (1994), documented particular state and federal program elements that promote effective technology use. The following factors have been found to be directly or indirectly related to the effective and sustained integration and use of technology and telecommunications in education.

- Careful planning that involves all stakeholders in education and technology
- State leadership to support sustained funding for the planned use of technology
- Technology incorporated into existing and emerging education initiatives
- Incorporation of technology applications into state curriculum frameworks and standards
- Coordination of education, business, and other relevant governmental agencies
- Business involvement in planning and implementing technology in education
- Increased involvement between community agencies and education agencies
- A statewide interoperable electronic information highway accessible by all classrooms and learning environments
- An interagency governance structure to secure and coordinate resources across agencies for technology
- Funding for school and district technology use plans that meet local and state criteria
- Site-level planning as a pre-requisite for receiving technology-based resources
- Guidelines for local planning that promote funding allocations for staff development
- Incentives for identification and dissemination of proven programs and practices
- A statewide educational technology clearinghouse with electronic distribution capabilities
- Incentives for the development and validation of technology-based resources
- Provisions for regional and local technology use training and technical assistance
- Both formative and summative evaluation of all programs
- Technology uses incorporated into program review and assessment guidelines
- A process to communicate program accomplishments and problems to stakeholders
- Informing policy-makers about cost-benefits of technology applications in education

C. Summary

This section focuses on the impact technology has on teaching and learning and reviewes the findings of research and experience about the benefits and appropriate uses of technology to enhance teaching and learning. Technology is related to increases in student performance when interactivity and other important features of instructional design are applied to its use. Teacher preparation, follow-up staff development, and technical assistance are critical prerequisites for effective technology applications. Planned integration of technology in education that directly

involves teachers consistently allows teachers to engage students in meaningful educational experiences and allows more time for individualized instructional opportunities.

Effective application of technology to support education involves careful review and re-planning of the classroom and school-level program. Research generally suggests that effective technology use is a complicated and involved process of planning and ongoing support with serious consideration of the current and emerging research findings on its use.

Support for national research and development for technology applications in education is critical to keep pace with emerging technologies. However, less than one percent of federal funding for technology research and development is dedicated to educational applications of technology. Evidence is mounting that there are still many unanswered questions about educational uses of technology, and therefore, more research is needed to inform educators and software developers about the most effective and needed uses of technology.

IV. RELEVANCE TO EDUCATION REFORM

How will the integration of technology and telecommunications support educational reform efforts from the state to the classroom level?

A. National Perspective

One of the core components of the Goals 2000 initiative is that all states will develop comprehensive educational plans to support the attainment of the National Education Goals. The NII (as it develops) and related technologies can be key supports for education reform efforts. Serious consideration should be given to educational applications of technology in plans under development at the national, state, and local levels. For these reasons the NCC-TET established a requirement to: *Integrate applications of the NII and related technologies into education (NCC-TET, 1994).*

Participants in the FARNet–CoSN Forum envisioned the information-age school as the locus and catalyst for active, collaborative, lifelong learning -- among educators, between teacher and student, among learners of all ages and conditions regionally, nationally, and globally, within the school, and between the school and community. For all these learners, networking and other advanced technologies are commonplace tools. The educator's traditional role expands to include facilitator, innovator, researcher, and electronic publisher. All stakeholders, including practitioners and parents, contribute to the school's site-based management and play active roles in decision-making about technology and instruction (Breeden, 1994).

In commenting on technology and reform, Forum participants concluded, "change will be neither swift nor easy." Many educational leaders have little understanding of or experience in using and managing advanced technologies; many practitioners are fixed in their attitudes toward using technology in the classroom; many communities view schools as "islands" and are accustomed to playing only a limited role in the formal education process. "The business community and schools too often continue to view one another as unfamiliar or unequal partners. However, the potential of networking to transform and revitalize education is a strong incentive for new ways of thinking (Breeden, 1994)."

Recognizing the responsibility to prepare students to work and live in a technological society, most states and school districts have adopted standards for teaching students with and about technology. For example, in a 1994 survey conducted for the Office of Technology Assessment (OTA), 43 states reported that they require or recommend integrating computers or information technology into the curriculum, and 19 states require high school seniors to demonstrate computer competency before graduating (Anderson, 1994). The ability to use technology has come to be recognized as an indispensable skill for students. The Secretary's Commission on Achieving Necessary Skills (SCANS) stated this in the starkest terms: "Those unable to use . . . [technology] face a lifetime of menial work" (SCANS, 1991).

B. Linking Education Reforms and Technology

During the past decade, the need for widespread education reform became the focal point of educators, politicians, and the general public. The 1983 publication, *A Nation at Risk*, helped to bring national attention to the declining effectiveness of schools in preparing students to be

contributing citizens. At about the same time, microcomputers were becoming increasingly available in schools. However, educators had few ideas for effectively incorporating technology into the instructional environment, escalating the growing national concern that schools were ineffective. The school reform movement had taken two different paths to address deficiencies in the educational system (Campoy, 1992):

- addressing the need for school improvement from within the existing educational system
- restructuring the entire educational system to focus on developing student-centered learning as opposed to the traditional textbook-based curricula

The first approach, spurred by the shortcomings identified in *A Nation at Risk*, sought to improve schools through stringent accountability requirements for the existing structure (Campoy, 1992). Reformers supporting this approach view technology as playing an important role in standardizing and automating instructional and administrative procedures so educators are better able to establish and monitor achievement of measurable goals.

The second approach, triggered by the Carnegie Forum on Education and the Economy report, *A Nation Prepared: Teachers for the 21st Century*, called for incorporating technology within systemic change. Those advocating the restructuring approach view technology as being an essential catalyst to bring about systemic change to education reform (Campoy, 1992; and Smith, O'Day, and Fuhrman, 1992). Restructuring with technology involves a shift to learner-centered instruction, cooperative learning opportunities for students and collaborative efforts for teachers, and a de-emphasis on the traditional school/class time constraints. This approach also involves active engagement in problem solving and assessment based on performance outcomes instead of isolated pieces of knowledge as measured in achievement tests (Bagley and Hunter, 1992; Newman, 1992).

In the last 10 years, educators have attempted numerous but fragmented approaches for incorporating technology into the education reform movement. In the *Educational Media and Technology Yearbook* for 1990, the editors issued a warning that we are in danger of repeating old mistakes. An excerpt is cited from a 1977 speech delivered by the first U.S. Secretary of Education, Terrel H Bell, addressing the snail's pace at which educational changes take place relative to technology.

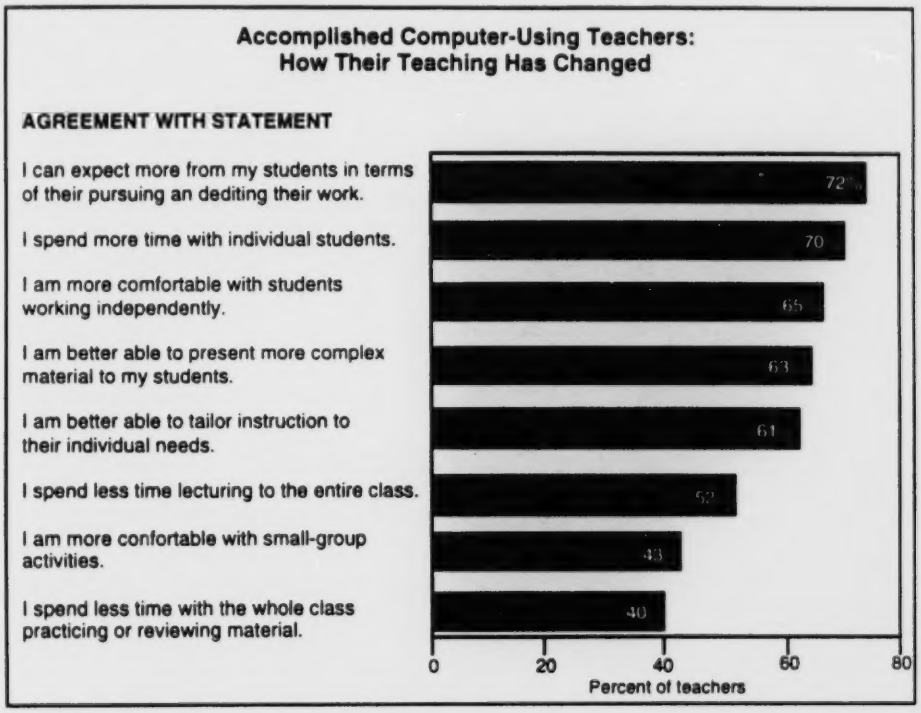
> *The education system is having a slow and difficult time adopting technological advances which could multiply the efficiency of instruction. Much of the task of storing and retrieving information and presenting it to students will be done by the computer . . . We must somehow learn to persuade the decision makers to shake up and change our approach to teaching and learning. The potential of technology must be used to provide the nation a more effective and productive education enterprise. American education is wobbling down an electronic avenue in an oxcart !*

Bell's comment is remarkably appropriate today, given the isolated quick-fix approach often adopted for including technology to facilitate school reform (Wood and Smellie, 1990).

C. Preliminary Research Findings

Technology is rapidly emerging as a critical component, as well as catalyst, for education reform. Far West Laboratory studied the impact of educational technologies from 1984 to 1991, conducted extensive research on the California Model Technology School Projects, and conducted a comprehensive state by state analysis of state educational technology plans and legislation. A study, *Accomplished Teachers: Integrating Computers into Classroom Practice,*

(Hadley and Sheingold, 1990), found that technology and telecommunications use changes teaching in ways that support current educational reform efforts. For example, the study reports that technology enables teachers to increase individualized student-centered work, spend less time lecturing to the entire class, better present more complex materials, and expect more from students. These findings are illustrated as follows:


Accomplished Computer-Using Teachers:
How Their Teaching Has Changed
AGREEMENT WITH STATEMENT
I can expect more from my students in terms of their pursuing an dediting their work.
I spend more time with individual students.
I am more comfortable with students working independently.
I am better able to present more complex material to my students.
I am better able to tailor instruction to their individual needs.
I spend less time lecturing to the entire class.
I am more confortable with small-group activities.
I spend less time with the whole class practicing or reviewing material.
72
70
65
63
61
52
43
40
0
20
40
60
80
Percent of teachers

The goal of systemic change -- recreating an education system in which all students can reach much more challenging performance standards -- puts the potential of technology in a different light. The question is no longer how to use technology to do the same thing better. The question is how to use technology to change practice to reach new goals -- as a catalyst for change and as a tool in creating, implementing, managing, and communicating a new conception of teaching and learning, as well as a system that supports it. The old goals assessed by standardized achievement tests will not fall by the wayside. In fact, there is evidence that "basic skills" as defined by these tests are learned at least as well, if not better, through the kinds of more intellectually challenging experiences (Knapp, 1992). The following chart presents an overview of shifts in teachers' beliefs and practices.

SHIFTS IN TEACHERS' BELIEFS AND PRACTICES

Shifts in Teacher Beliefs and Practices About:	Instruction	→	Construction
Classroom activity	Teacher Didactic	→	Learner centered Interactive
Teacher role	Fact teller Always expert	→	Collaborator Sometimes learner
Student role	Listener Always learner	→	Collaborator Sometimes expert
Instructional goals	Facts Memorization	→	Relationships Inquiry and invention
Concept of knowledge	Accumulation of facts	→	Transformation of facts
Demonstration of success	Quantity of memorized facts	→	Quality of understanding
Assessment	Norm-referenced Multiple-choice instruments	→	Criterion-referenced Portfolios and performances

Numerous examples of how technology can be used to transform teaching and learning exist across a wide variety of students and settings. These examples demonstrate that, under certain conditions, technology can stimulate and facilitate the introduction of project-based activities, student and teacher collaboration, and cross-disciplinary work. These experiences also document a range of outcomes that extend well beyond skill-based multiple choice terms.

Each of these efforts demonstrates that technology can be the vehicle for significantly changing what happens in classrooms and greatly expanding how and what students learn. For example, it has been reported that high school students, after four years of exposure to computers as tools for exploration, "became independent and collaborative problem-solvers, communicators, record-keepers, and learners with the computers" (Tierney, et al 1992).

Although these interventions differ in technology applications, subject matter, student characteristics, and numerous other factors, they share three significant factors.: first, they are based on the premise that understanding and problem solving require activities that engage students in constructing knowledge; second, they incorporate intensive support for teachers' professional development; and third, they involve only a small number of classrooms or schools.

In fact, the success of these projects has less to do with technology and more to do with the philosophy of learning and conception of professional development that they embody. Project staff provide ongoing assistance, facilitation, and professional development to teachers in support of transforming their practice. These knowledgeable people are available on site and online to guide, cajole, and answer questions, as well as to offer specific training, development, and support. These support staff are learning alongside teachers what it takes to create inquiry-based learning environments. This is a far cry from the traditional workshop/training model of professional development. It is much closer to the kinds of learning opportunities teachers are asked to create for students (David, 1994).

D. Learning Reform Enhanced by and Supportive of Technology

Effective computer and telecommunication use requires a different educational model. School reform advocates have pushed for "changes to educational models" for many decades. Yet, only recently has technology presented much of an interest to them. With the advent of graphics processing and hypermedia authoring, the computer has become as powerful a tool for constructing knowledge as it has been for information consumption. Constructivism, one of the theories promoting a new educational model, requires children to invent their own ideas. The Institute for Learning Technologies at Columbia University, describes the Constructivist agenda as primarily motivated by "a recognition that most, if not all, knowledge domains are complex and ill-structured in a number of ways that require a mastery and experience with a broad range of cases that reflect the complexity and diversity of the field" (The Institute for Learning Technologies, 1994). Constructivists feel that learning requires a significant degree of practical experience with the application of principles, and that the learning process operates through acculturation, like natural language knowledge and skill. More specific practices, such as 'cognitive apprenticeship' and 'collaborative learning,' emerge from these general principles, creating an ideal environment for information production via computer. Means and Olson (1994) outline five features of reformed classrooms, using a long-term class assignment called *Local Heroes Project* to illustrate their points:

1. *An authentic, challenging task is their starting point.* Picking their own topic, a fifth grade class with limited proficiency in English at Frank Paul Elementary School decides to write about local minority leaders. This project includes creating their own materials by conducting and videotaping interviews and then composing written highlights.

2. *All students practice advanced skills.* Complex tasks involve both basic skills and advanced, higher level thinking skills. Students prepare for interviews by analyzing interviews with famous people and then develop questions to elicit certain information and generate interesting responses.

3. *Work takes place in heterogeneous, collaborative groups.* The class realizes the difficulty of individuals conducting interviews and taking notes at the same time, so they split into groups of three. Students help each other transcribe the interviews and log the video footage.

4. *The teacher is a coach.* Unlike older practices of fading into the background, the teacher provides the structure of the project and actively supports students' performances and reflections. The teacher facilitates the higher level questions and helps students overcome self-consciousness before interviewing.

5. *Work occurs over extended blocks of time.* "Serious intellectual activity" doesn't fit into 50-minute periods for a set number of days. Long term projects like this challenge the conventional schedule filled with small blocks of instructional time (Sewell, 1995).

The *Local Heroes Project* relies on technology to operate, while not allowing machines to become the driving force behind the learning. The authors point out that "our observations in settings that couple technology with education reform suggest that the technology certainly amplifies what teachers are able to do and what they expect from students" (Means and Olson). One reason that technology has this positive effect is that teachers see complex assignments as feasible. Database programs with graphing capabilities help teachers understand the possibilities of longer term projects with extensive data collection and analysis. When these projects combine research with other schools over the Internet, exciting new discoveries can be made. A popular

activity called the *Shadow Project* teaches children about triangulation, the circumference of the earth, and averaging data. Students first measure the length of a shadow cast by a ruler at high noon and then they find the class average of the measurements. The results are exchanged with other participating schools across the world and provide enough information to calculate the circumference. Once again, the technology simply enables the projects to occur without controlling the content (Sewell, 1995).

E. Technology Facilitates Transformations in Thinking and Working

When the Apple Classroom of Tomorrow (ACOT) entered its third year, new insights continued to be gained. An in-depth study of a sample of students' thinking processes began to show significant change in the way they thought and worked. Teachers began teaming, working across disciplines, and modifying school schedules to accommodate ambitious class projects. Most teachers also used the technology as a tool to accomplish personal tasks. In addition, teachers' lessons and students' projects began demonstrating mastery of technology and frequently integrated several kinds of media. The comment of a teacher at the high school expressed a common sentiment:

> *As you work into using the computer in the classroom, you start questioning everything you have done in the past, and wonder how you can adapt it to the computer. Then, you start questioning the whole concept of what you originally did. I guess I have to realize that what I am doing is learning how to undo my thinking.*

For this teacher and others, personal efforts to make technology an integral part of their classrooms opened them to the possibilities of redefining how they went about providing opportunities for students to learn.

By the end of year four, ACOT classrooms had become an interesting mix of the traditional and nontraditional. Teachers were experimenting with new kinds of tasks for students. In addition to becoming comfortable with new patterns of collegial interaction, they also encouraged far more collaboration among their students. In most instances, teachers had altered the physical setup of their classrooms and modified daily schedules to permit students more time to work on projects. They also provided more opportunities for students to use a broader mix of learning and communication tools. Finally, teachers struggled with the need for new methods of evaluation that could capture the unique ways students were demonstrating their mastery of skills and concepts. Experimentation with both performance- and portfolio-based assessment began throughout most sites (Dwyer, 1994).

F. Summary

This section addresses the relevance of technology to educational reform, as well as its effects on education reform efforts from the national to the classroom level. The overview makes the point that technology can serve as a catalyst to promote educational reform. The National perspective discusses the role of technology to support educational reform as suggested in Goals 2000 and the Improving Americas Schools Act. Both indicate that attainment of the National Education Goals can be greatly facilitated by the appropriate use of technology. Technology can increase opportunities for students to engage in the challenging and enriching curriculum -- especially in rural areas where students are typically isolated from educational opportunities taken for granted in urban regions of the country.

This section documents many examples of how technology, if properly applied, can move teachers' beliefs and practices from instruction to "construction". It can shift instruction from Teacher didactic to learner-centered and interactive, from fact telling to teacher-student collaboration, from memorization to inquiry and invention, from the accumulation of facts to the transformation of facts, and from the use of standardized tests to relevant portfolio and performance-based assessments.

V. EDUCATIONAL TELECOMMUNICATIONS POLICY

What is the range of policy issues related to the use of telecommunications in education.

A. National Perspective

Far West Laboratory has conducted extensive reviews of more than 20 policy statements on education and the NII. Most national education organizations and agencies have developed policy guidelines, platforms, and recommendations for the use of technology in education, including the Council for Educational Development and Research, National Education Goals Panel, the Council for Chief State Schools Officers, the United States Distance Learning Association, and others. In every case there is much emphasis on application and integration, as well as access to the network. In a variety of ways the policy documents emphasize the following statements:

- Ensure that educators have the staff support, training, time, authority, incentive, and resources necessary to use technology effectively
- Ensure that the state, districts, and schools have sufficient funding to initiate and sustain on-going use of technology
- Ensure that students and school personnel have equitable access to technologies for their learning, teaching, and management needs
- Encourage the development and expansion of telecommunications networks in ways that will connect all classrooms
- Develop national leadership to support learning technologies
- Consider technology in any efforts to reform and restructure education
- Redesign national school systems to prepare students for the 21st century

The OTA found that most earlier policy discussions and technology initiatives tended to focus on hardware and software acquisition, and student access to technology. However, in the enthusiasm to get technology to students, and in the context of limited resources, teacher issues have been shortchanged. When teacher needs are discussed, the emphasis is often on providing short-term training to familiarize teachers with a specific application or encourage general computer literacy. Seldom have policy discussions or initiatives centered on the relationship between technology and the teacher's role; seldom have they articulated a vision of how technology can empower teachers to carry out all parts of their jobs (OTA, 1995).

B. NCC-TET Requirements for Education and the NII

The NCC-TET's 19 requirements and policy guidelines for education and the NII (1994) are summarized as follows:

Access Requirements

- Ensure that all learners have affordable and equitable access to the NII.
- Ensure that the NII is accessible in a variety of learning environments.
- Develop a variety of sustained public and private partnerships and funding.
- Make public and private information resources available.

Application Requirements

- Coordinate NII-related education activities conducted by federal departments and agencies.
- Develop and disseminate NII guidelines for education.
- Identify and disseminate effective education and training applications.
- Integrate applications of the NII into education reform.
- Develop quality education and training applications.
- Conduct research on the education applications.
- Promote professional development and technical assistance.
- Support on-going evaluation of the effectiveness and impact of the NII.

Technical Requirements

- Emphasize interactive, broadband transmission of interactive voice, video, and data.
- Provide seamless interconnection among networks.
- Guide the development of voluntary standards to promote interoperability.
- Ensure that the NII is easy to use.
- Develop "navigation" systems for locating resources on the NII.
- Support user collaboration.
- Create adequate security measures for network resources.

C. The Council of Chief State School Officers Telecommunications Policy Report

The Council of Chief State School Officers (CCSSO), under a cooperative agreement with the National Telecommunications and Information Administration (NTIA) of the U.S. Department of Commerce, recently released a report on telecommunications and the National Education Goals through its *United States Education and Instruction through Telecommunications* (USE IT) project. USE IT draws upon the expertise of key individuals from education, government, and private industry to make recommendations for telecommunications and distance learning in education and the NII. USE IT recommends:

- Education agencies at all levels must support development and use of distance-learning to achieve the National Education Goals.
- The telecommunications industry, distance-learning service providers, and regulatory agencies must support and develop distance-learning delivery systems that are compatible and interoperable.
- The federal government should promote public/private partnerships for distance learning and support regional and statewide applications of distance learning as an integrated nationa resource.
- Federal regulatory agencies must develop policies that ensure affordable rates for the educational uses of telecommunications resources.
- Federal and state agencies, in cooperation with the private sector, should develop new resources for investment and capital development distance learning.
- National authorities should undertake awareness and outreach activities to inform educators, business and industry, and the public of the value and importance of distance learning to achieve the National Education Goals.

D. U.S. Department of Commerce Guidelines

Following are the technology attributes recommended in the Department of Commerce publication, *Putting the Information Infrastructure to Work: A Report of the Information Infrastructure Task Force Committee on Applications and Technology* (1994).

To serve the needs of the educational community in the long term, an improved NII must have the following attributes:

- *Convenient and equitable access.* Connection to every American classroom, public library, and other learning locations will ensure that NII applications are available to all citizens as instructional tools.
- *High speed transmission capability.* The NII will permit the interactive transmission of voice, video, data, and multimedia applications as needed to support education, training, and lifelong learning.
- *Easy use.* User interfaces will be simple and easy to use; networks and applications will be interoperable to permit easy access from all hardware platforms to the widest possible array of resources.
- *Security.* The NII will accommodate security systems adequate to protect privacy of users as well as to safeguard intellectual property rights.
- *Content.* The NII must offer information, communication, and learning opportunities that meet high standards of quality and help America attain the National Education Goals and necessary occupational skills standards.
- *Instructional integration.* Institutional integration will be the most difficult challenge to meet. New instructional capabilities will first have to be integrated into the routine daily practice of our current educational and workplace institutions.
- *Professional development and technical assistance.* Teachers, administrators, and education and training personnel need access to professional development opportunities on a much wider and more in-depth scale than is now the case. Ongoing assistance is necessary to help educators select resources, get connected the NII, and provide for needed maintenance of the system.

E. Summary

This section briefly reviewes current national policy platforms addressing telecommunications and education which consistently promote the same message for education's role in the NII. Policy reports summarized include the Council of Chief State School Officers and the Department of Commerce. The most complete set of recommendations for education and the NII are found in the NCC-TET, *Requirements for Education and Training*, which focuses on: 1) access by all learners to the NII from a variety of learning environments, 2) application requirements that stress the need for adequate training, meaningful content on the network, and professional development for the use of the network, and 3) technical requirements that emphasize the need for educators to have technology that allows for easy access and seamless interconnection, as well as user-friendly electronic navigation systems to help teachers find relevant resources on demand.

The major issue seems to now move beyond policy and to implementation. The policy statements have defined parameters and provided initial guidelines for technology and telecommunications use in education, and efforts to implement such policies have already been

initiated at the federal and the state levels. For example, the NCC-TET has taken its statements and incorporated these as the rationale for the introduction of important amendments to the telecommunications reform legislation considered by the 104th Congress. Now this legislation promotes "affordable access" to the NII for education. The FCC and the White House are actively promoting increased access by educators and learners to the NII. For example, the White House sponsored "Tech Corps" recently announced by President Clinton as a national initiative that would ask all business and industries to work with local communities to assist teachers and student in accessing technologies through volunteer programs, loaned executives to schools for training, electronic field trips to industry for students, and many other ideas.

VI. ACCESS AND APPLICATIONS

What is the current situation with respect to teacher and student access to telecommunications and relevant content on the network?

A. National Perspective

Access by teachers and learners to the NII is another major issue for the NCC-TET. Accessing the best and most recent information to do a job or perform a task must become a cultural norm by the end of the century. Yet, almost 90% of K-12 classrooms lack even basic access to telephone service (Princeton Survey Research Associates 1993). Schools have not been the beneficiaries of the universal service policies that resulted in the delivery of basic service at affordable rates for most American homes. When classrooms do have phone lines, schools are typically charged at the corporate rate for telephone service.

The goal of connecting every home and classroom to the NII should be set for the year 2000. An interim goal of providing at least one connection to every school building and educational site in the nation can be achieved almost immediately. This is needed to implement NCC-TET Requirement 1: *Ensure that all Americans have affordable access to the NII.*

The applications of the NII should extend into homes and workplaces, as well as schools, institutions of higher education, libraries, and arts and cultural institutions. The vision of the NII is one in which learning occurs in a variety of environments throughout the course of one's life. The NII should make it possible for individuals to gain access to the resources they need when and where they want it. The principle of "learning on demand" should guide the design of all NII-related education and training programs funded by the federal government. Thus, NCC-TET proposed Requirement 2. *Ensure that the NII is accessible in a variety of learning environments.*

A majority of schools are ill-equipped to take advantage of the potential presented by telecommunications networks. Moreover, most schools lack the connectivity, administrative and organizational support, and technical expertise needed to integrate networks into teaching and learning. Teachers spend a great deal of their time helping, counseling, and sharing information with students and parents; yet they are expected to do so in most cases without the aid of technology. Telephones, perhaps the most ubiquitous and necessary technology available to other professionals, are rare in most K-12 classrooms. Only an estimated 12 percent of teachers in this country have a telephone in their classrooms, and less than 1% have voice-mail (Becker, 1994). As one teacher pointed out, "telephones may be the only tool we don't give teachers because we are afraid they will use them" (OTA, 1995). Some teachers stand in line to use the one phone available to them (in some cases, a pay phone) in the teachers' lounge or principal's office, to make arrangements for field trips, for bringing guest speakers into their classes, or for scheduling parent volunteers. A national survey suggests that the main reason teachers want telephones in their classrooms is to contact parents about immediate problems or concerns, such as student behavior, attendance, and completion of homework (Becker, 1994).

B. Current Reality Regarding Access and Use of Technology in Schools

Recent surveys show we are developing a nation of education 'haves' and 'have nots' with respect to access and use of the information highway. The OTA documented that while 75% of

public schools have access to some kind of computer network, and 35% of public schools have access to the Internet, only 3% of instructional rooms (classrooms, labs, and media centers) are connected to the Internet (OTA, 1995).

A substantial number of teachers report little or no use of computers for instruction. Their use of other technologies also varies considerably. The U.S. General Accounting Office (GAO) finds most of America's schools are unprepared for the 21st Century in critical areas, including crucial access to information technology (1995). Following is a review of findings of recent studies on telecommunications and technology access:

A GAO survey of a representative sample of 10,000 schools found:

- Overall, the nation's schools were not even close to meeting their basic technology needs.
- Many schools that have computers and television sets have little or no infrastructure, such as modems, phone lines, conduits, fiber optic, and other means of connectivity to fully use the technologies.
- Schools in central cities and schools with a 50% or more minority population were more likely to have insufficient technology access than other schools.
- Only a few schools have state-of-the-art communications technology.
- Over half of America's schools have inadequate facilities or buildings for networking any type of technology, and as a result, cannot justify its purchase.

The annual study by Quality Education Data, Inc. (QED, 1995) reports:

- Almost none of the nation's public schools meet the research-based optimum of five students per computer with the average district having one computer for every 12 students.
- Most of the growth in technology access is in moderate to wealthy school districts.
- Schools with a ratio of 24 students to one computer are those with the highest poverty and multi-ethnic populations and are found in 43 of the 50 states in both urban and rural areas.
- QED estimates that an investment of approximately $400 million would bring the bottom 10% of districts and their students up to the national average of students per computer.

The recent OTA study, in its extensive assessment of teacher preparation for the effective use of technology in education, found:

- Despite available technologies in schools, a substantial number of teachers report they do not use computers and other technologies regularly for instruction.
- A majority of teachers report feeling inadequately trained to use technology resources, particularly computer-based technologies.
- Technology is not central to the teacher preparation experience in most U.S. colleges of education today.
- Districts spend far less on teacher training than on hardware and software.
- Training focuses on the mechanics, not on integrating technology in the curriculum.
- Teachers lack an understanding of curricular uses of technology and lack models of technology for their professional use.
- States, schools, and districts need technology planning and leadership in order to make extensive and effective use of technology.

The National Center for Education Statistics (1995) reports the following:

- Overall, 35% of public schools have Internet access, but only 3% of all instructional rooms (classrooms, labs and media centers) in public schools are connected to the Internet.
- Funding is the major barrier most often cited in the acquisition or use of advanced telecommunications in public schools.
- Seventy-five percent of public schools have computers with some type of telecommunication capabilities (i.e., local area networks or wide area networks).
- Smaller schools with enrollments of less than 300 are less likely to be on the Internet than schools with larger enrollment sizes.
- Only 30% of small schools reported having Internet access, while 58% of schools with enrollments of 1,000 or more reported having Internet access.

An American Electronics Association (1995) survey concludes:

- The NII in schools would benefit curriculum content, increase computer skills for students, increase student motivation, provide greater opportunities for students for independent investigation and research, and increase access to information for educators.
- The NII would equalize opportunities for economically disadvantaged and disabled students.
- In order for the NII to be successfully implemented in schools, sufficient funds and equipment, adequate training of educators on the availability and use of information technologies, and inexpensive access to telecommunications is essential.

C. Access Goes Beyond Connectivity

One basic prerequisite for effective teacher use of technology is access. Schools have made substantial investments in hardware and software over the past several years, increasing their technology inventories. However, OTA finds that despite past investments in technology, many schools still lack the basic technology infrastructure to support the most promising applications of educational technology. About half the computers in U.S. schools are older, 8-bit machines that cannot support CD-ROM-sized databases or network integrated systems or run complex software. This outdated inventory prevents teachers from using some of the most exciting applications of computers -- information gathering from networked databases or CD-ROM encyclopedias, desktop publishing, mathematics instruction using analytic graphing and calculating software, and collaborating in projects over networks.

Some schools do not always fully utilize the existing equipment, and some do not always locate technology in the most accessible places. Most computers are still in labs rather than in classrooms, and modems may be located on a central computer in the principal's office, making it hard for teachers to use them during the course of a day. Thus, it is not surprising that computers are not used very often (about two hours per student per week, according to coordinators; less, according to the students). Technology is not used regularly in the teaching of academic subjects -- only 9% of secondary school students reported using computers for English class, 6 to 7% for a math class, and 3% for a social studies class. The most common uses of computers are for basic skills practice at the elementary level and word processing and other computer-specific skills in middle and high schools. Other uses, such as desktop publishing, developing math or science reasoning with computer simulations, gathering information from databases, or communicating by electronic mail (e-mail) are much more rare. Despite the growing interest in

connecting schools with information resources like the Internet, most school districts with local area networks do not always configure or use them for the most up-to-date applications (OTA, 1988).

OTA finds that it is necessary to consider a new definition of what constitutes "access" to technology by teachers and students. Counts of equipment, student-computer ratios, dollars spent and requirements, while important, alone are not sufficient to define meaningful access to technologies. It is appropriate rather to consider infrastructure in a broader sense: type of technology (including older but overlooked resources such as the telephone), age, capacity, connectivity, software, and services. Organizational arrangements -- the placement and flexibility of technology -- also affect the ease of use by teachers and students. For example, a cart of laptop computers that can be moved anywhere in a school may be used much more often than a computer lab far from the classroom. An additional component of a new definition of access includes the kinds of support teachers need to use the infrastructure effectively: exposure to innovative uses, flexible "just-in-time" training, and ongoing technical support and expert advice.

If access to technology is an equity concern, then the definition should be expanded to encompass access to necessary information. Telecommunications and networking technologies, in particular, may create incomparable opportunities for teachers and students to gain immediate access to information. With hardware like CD-ROM players, the excitement and power of video can be combined with the information transmission power of the computer and communication capabilities of high speed networks. Connectivity is likely to become the major technology issue of the next several years. Major investments of time and other resources will be required to prepare schools to effectively access the information and electronic communities telecommunications can provide (OTA, 1995).

D. Access to Needed Time, Support and Training

Other barriers in many schools hamper more effective use of technology by teachers. These include lack of time, inconvenient scheduling, attitudinal barriers, and barriers of school organization, curriculum, testing, and other policies.

In general, teachers have little in the way of technology support or training available at their schools, although many teachers seek training on their own. Furthermore, the kind of training, not just availability, is important. Much of today's educational technology training tends to focus on the mechanics of operating new machinery, with little about integrating technology into specific subjects, how to choose software, and how to organize classes, e.g., to use four computer workstations or a single computer with a modem.

Regular, onsite support for technology use is an even more daunting problem. Only 6% of elementary, and 3% of secondary schools have full-time school-level computer coordinators; in nearly three-fifths of schools, no one had any portion of their work-week officially allocated to coordinating computer activities. Even in schools where someone is designated to spend at least half of his or her time as computer coordinator, very little of this time goes directly to training or helping teachers use computers.

Probably the greatest barrier to technology use, however, is simply lack of teacher time -- time to attend training or workshops, to experiment with machines and explore software, to talk to other teachers about what works and what doesn't, and to plan lessons using new materials or methods. The diverse jobs teachers are asked to do and roles they are asked to play also affect their ability to take on another challenge. Teachers are given very little compensated staff development time,

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which competes agains multiple demands for this time. Unless there are significant changes to the rhythm of the school day or changed incentives for giving teachers more time to learn and experiment with new technologies, this barrier to technology use will remain immense.

Data on expenditures for educational technology indicate that far more resources have been allocated to hardware and software than to training or technical support. For example, in 1992-93, a national survey asked district technology coordinators to estimate how much of their total district computer budgets fell into each of these three categories. This survey found that approximately 55% of all technology spending goes to hardware, while software spending accounts for another 30%. Training accounted for only 15%. At one point in time, districts expected that teachers would create software and budgeted no dollars toward software purchasing. That has changed dramatically over the past 10 years. If any problem remains, it is found in the percentage of overall budgets devoted to computer training (MDR, 1993).

E. Guidelines for Increasing Access to the NII

A review of the available information strongly suggests that the following conditions must exist in order to provide access and effective educational use of the NII.

- Schools, libraries, workplaces, and other learning sites will have high speed access to the NII, capable of supporting interactive multimedia applications.
- Interactive, multimedia, high-quality educational applications for students in the basic learning areas and at different skills levels will be affordable and readily available in the marketplace.
- Schools will have internal networking capabilities and hardware capable of supporting high-quality applications.
- National and state education goals will be supported and enhanced by applications of technology in all learning environments.
- Technology will be integral to national, state, and local educational reform and will be part of the planning and implementation of all education reform efforts.
- Making the NII a reality for education will require significant capital investments by the private sector as well as commitments from national and state government.

F. Summary

This section focuses on access and applications and addressed the current situation with respect to teacher and student access to telecommunications and its relevance for education. Access by teachers and learners to the NII is a major issue facing the country and the states. This section points out the high level of interest and concern recently raised from several studies conducted by the General Accounting Office (GAO), Quality Education Data (QED), the National Center for Educational Statistics, and the American Electronics Association (AEA). A major point made is that access goes beyond connectivity. Teachers need time, training, and meaningful educational resources which are available on the network.

VII. PLANNING AND INSTRUCTIONAL INTEGRATION

What does experience and research have to suggest about planning for effective integration of telecommunications into curriculum and instruction?

A. National Perspective

It has been repeatedly found that careful planning is a prerequisite for the effective application of teaching and telecommunications in education and training. Lessons about planning for technology have made their way to national guidelines and programs. For example, national education reform agendas encourage states to have incentives and direction for developing technology and NII application plans. Plans should 1) involve education stakeholders in their design; 2) be guided by education and training needs of learners; 3) specify clear objectives related to national and local education goals; and 4) incorporate technology applications and practices that have been tested for their educational benefits (NCC-TET, 1994).

Some educators think access, training, and onsite assistance are the primary supports necessary to facilitate widespread technology use among teachers. While these factors are important, OTA (1995) finds they are not sufficient to assure that technology will be explored and used by the majority of teachers in a school or district. Other factors that affect whether teachers use technology resources include policies that encourage teacher experimentation and collaboration, the presence of incentives for teacher use of technology, administrative leadership about technology, and public understanding and endorsement of the importance of technology as a learning and teaching tool. Three of the most critical among these are:

- having a vision and plan for using technology to meet instructional and professional goals
- evaluation and assessment policies that encourage technology use
- staff development designed to directly support implementation of the school and classroom level plan

Many school systems have not begun to explore the ways that technology can help them function better or differently as institutions and workplaces. Few teachers have been encouraged to view new technologies as professional tools that can help them do their jobs better, more efficiently, or in new ways. For many teachers, the technology that has most revolutionized their working life has been the photo-copying machine. Yet, some teachers report that access to and use of copying machines is restricted or cumbersome in their school buildings. When so many schools do not encourage teachers to use even the most basic labor-saving tools, it is not surprising to find that teachers are not supported in using more advanced technologies.

B. A Research-based Approach to Effective Planning for Technology Integration

Technology is rapidly emerging as an important component of teaching and learning and reform in American schools. However, technology is often promoted as the solution for improving learning before teaching and learning needs are even identified. In fact, research consistently shows that technology per se does not make school reform happen (Means, 1993). In order to

effectively target technology to support teaching and learning, it is necessary to engage in careful planning at the state, school district, school, and classroom level. Technology is often promoted as the solution for improving learning before teaching and learning needs are even identified.

District and school-level planning

A study of the initial implementation of California's state funded technology programs found that technology was not becoming institutionalized because it was often treated as a separate component within the state's education infrastructure. It was initially funded as an "add-on" rather than being integrated into the curriculum and incorporated into the mainstream of instructional programs.

For example, technology applications initially did not appear in state or local district curriculum framework guidelines, were not part of the school improvement initiatives, and often were not considered in school level program evaluations. At the school level teachers were often not involved in decisions about technology applications. Even so, the study showed that technology had a positive impact on teaching and learning when teachers and principals worked together to plan how to focus technology use in the classroom on regular curriculum activities.

The effects were even greater when the development and implementation of a school plan were actively supported by the district (Cradler, 1991). A recent study compared the comparative impact of technology implementation between schools that used varied levels of planning and staff involvement. The results clearly supported the need for careful planning with teacher involvement to produce commitment to sustained integration of technology into teaching. It went on to recommend the State continue to fund technology programs that require local planning rather than distribution of funds on an 'entitlement' basis (Ford, 1993). Reports from recipients of the California School-Based Grants consistently indicate that the strong emphasis on planning for these grants is a positive feature of the program:

> *Because we planned the project, we felt direct responsibility for implementation. . . it was sometimes hard to plan activities but the planning process made it easy to implement the project . . . now it has become the main focus . . . the grant proposal and the plan acted as a real good blueprint.*

These comments are typical of the many positive reports validated in the surveys, interviews, and site visits in a comprehensive study of 321 recipients of School-Based Grants that was conducted by Far West Laboratory (Cradler, 1992). Most of the quantitative and qualitative data collected from the grant recipients showed the planning process was an important factor leading to the successful completion of educational technology projects. The study further showed the planned application of technology helped to ensure the needs of students and teachers are clearly addressed in ways that support the California Curriculum Frameworks.

Classroom level technology planning

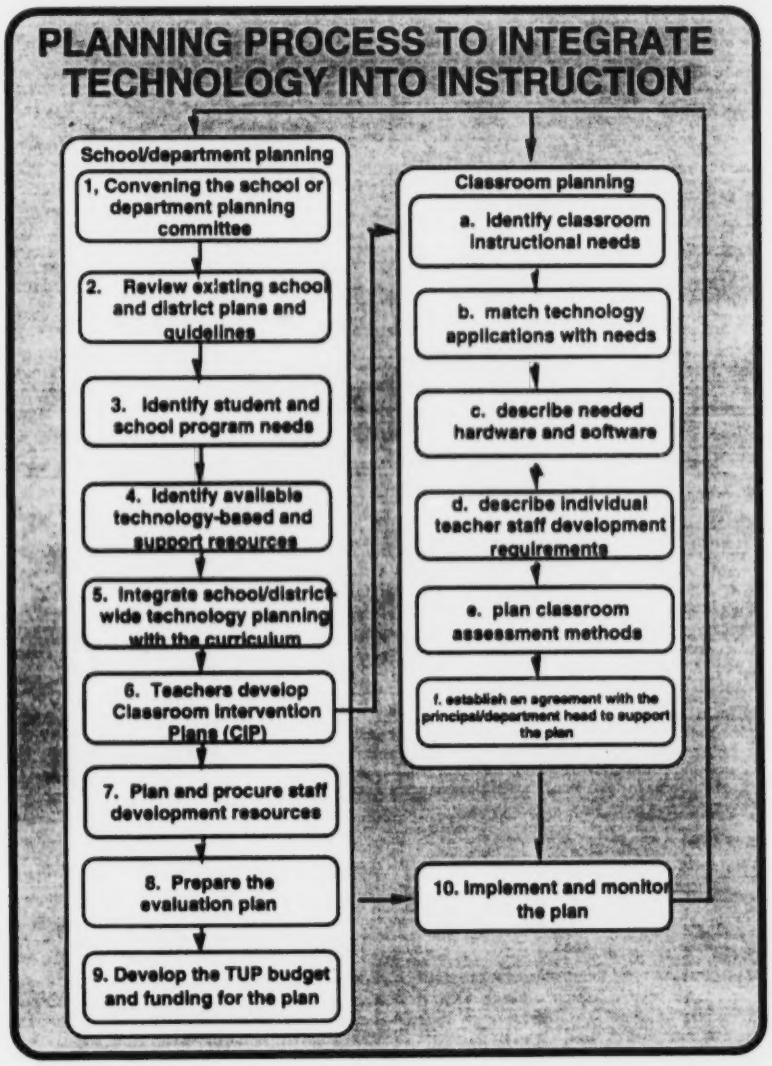
More recently, a major study on the teacher-applications of telecommunications and Internet resources (the Telemation Project) showed that the systematic approach to implementation was the key to success of the project (Far West Laboratory, 1995). Borrowing upon the findings of the Monterey and Cupertino Model Technology Schools Projects, the Telemation Project took the approach that teachers would only find telecommunications relevant if theyhad an opportunity to conceptualize and implement a classroom level project or plan for telecommunication use. This approach provided each teacher with a framework that defined the instructional strategies, curriculum objectives, student needs, and assessment strategies that could be supported by telecommunications. The result was that each teacher devised a Classroom

Telecommunications Intervention Plan (C-TIP). Over 100 C-TIPs have been developed, implemented, and are being updated and shared with other teachers online.

C. Developing a School and Classroom-level Plan

The comprehensive studies of technology application over the past five years on the California Model Technology Schools Projects yielded findings which identified the critical components in school and classroom level technology use planning (Cradler, 1992). The remainder of this article describes the minimum components for an effective *Technology Use Plan* (TUP) followed by specific steps for developing and implementing the plan.

The planning process described in the following pages should be considered when developing a school-based educational technology project. The planning steps illustrated below and explained in the following pages are advised for planning, implementing, and evaluating a school-based technology plan.


PLANNING PROCESS TO INTEGRATE TECHNOLOGY INTO INSTRUCTION
School/department planning
1, Convening the school or department planning committee
2. Review existing school and district plans and guidelines
3. Identify student and school program needs
4. Identify available technology-based and support resources
5. Integrate school/district-wide technology planning with the curriculum
6. Teachers develop Classroom Intervention Plans (CIP)
7. Plan and procure staff development resources
8. Prepare the evaluation plan
9. Develop the TUP budget and funding for the plan
Classroom planning
a. Identify classroom instructional needs
b. match technology applications with needs
c. describe needed hardware and software
d. describe individual teacher staff development requirements
e. plan classroom assessment methods
f. establish an agreement with the principal/department head to support the plan
10. Implement and monitor the plan

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1. Convene a school or departmental planning committee. Identify the planning partners to include the teachers, a district office representative, parents, the principal, possible business and community partners, and a representative from the county office, regional agency, or department of education as appropriate. Most middle schools and high schools are organized by departments and develop technology plans by department rather than school-wide. The decision to develop a school-wide vs. a departmental plan is a function of the size and organization of the particular school. Effective projects continue to involve advisory groups in the planning, as well as for ongoing support, monitoring of the project, and revision of the plan when needed. Technology use planning should be part of existing local school planning procedures. This will help to ensure that technology will become integrated into the existing educational program. Staff from a school that implemented this approach commented:

> *. . .Most of our planning for technology is now done through our existing planning committee, and our project was included in our local program evaluation .*

2. Coordinate with existing school and district plans and guidelines. Identify and review the existing school plans and guidelines for amending such plans. The TUP should become an integral part of the existing school plan already required by some programs such as School Improvement Plans (SIP). It has been found that technology plans are short lived if they are not integral to the overall plan and consequently considered a part of the overall school program. This suggests that educators should update the overall school plan to describe the use and coordination of existing as well as planned technology to support or expand the educational objectives of the plan.

The TUP must be consistent with existing or anticipated district level educational and technology planning. Successful technology projects usually implement activities that support the district-wide mission and goals. District support is necessary for the support needed to implement and continue with district resources after state funding is terminated (Cradler, 1993).

3. Identify student and school program needs. Review local needs assessment information, resource inventories, school performance and school accreditation reports, and other relevant information, to determine needs for restructuring or expansion with consideration of the application of technology. If time and resources permit, a needs survey should be conducted. The TUP should identify the student and staff needs to be addressed by the plan. Needs should be documented by the school staff and be focused on discrepancies between existing and desired conditions for teaching and learning.

4. Identify available technology-based and support resources. Review the existing uses of technology and media resources at the school and their relationship to the goals and objectives of the existing or emerging school site plan. Existing and planned school and district resources to support the TUP should be considered and described in the plan. Often plans are developed without consideration for the technology that already exists in the school or district. Also, plans sometimes budget for staff services that could be provided by the existing regional agencies or even the school district office. One grant recipient commented:

> *We found that the technology use planning process provided us with a structure that helped to define and organize better use of our existing school and district technology resources for the project.*

In addition to local resources, become familiar with the existing state, regional, and national resources, such as those provided by regional support agencies and demonstration programs. It is critical that educators are aware of the resources and possible uses of technology before they engage in intensive planning.

5. Integrate the school-wide technology planning with the curriculum. The TUP should describe how the use of technology will align with and expand district and state curriculum and instructional objectives. Technology should be viewed as a tool to expand opportunities for learning beyond what can already be provided. A technology using educator stated that:

> *The use of technology can greatly enhance traditional curriculum by expanding opportunities for student-initiated learning and problem solving and provide simulations of experiences not possible in the classroom.*

A recent study to determine effective technology applications concluded that "any technology integration requires that teachers engage in rethinking, reshifting, and reshaping their curriculum" (Means, 1993). The planning process should provide the opportunity for educators to become aware of and discuss the possibilities for current and emerging technologies to expand and enhance teaching – it should allow teachers the opportunity to collaboratively construct new visions for teaching and learning.

6. Objectives and activities. A plan should describe school-wide objectives with related activities that describe how technology applications directly relate to instruction, curriculum enhancement, and the school program. The objectives should be directly linked to the documented learner and teacher needs. Studies consistently show that plans which include clearly stated activities were more often used by staff as a guide for implementing technology. Clearly stated objectives make it possible to assess the level of implementation of the plan. After careful review of the instructional needs that can be met by the addition of technology, revise the objectives for the existing school plan, or add new objectives to incorporate the intended use of technology at the school site and in the targeted classrooms. Make sure that the objectives for technology applications are aligned with the district priorities or that the district supports the objectives.

7. Classroom level intervention. In addition to school or departmental objectives and activities, the TUP should describe activities planned for each classroom. Research shows that planning is most effective when it is extended to the classroom and describes what teachers should do to implement their part of the plan. Linking planning to the classroom level ensures that teachers will have a clear vision of their role in implementing the school-wide TUP.

The Monterey Model Technology Schools Project devised a school-and classroom-based planning model known as the *Classroom Intervention Plan* (CIP) to ensure classroom linkage to the school plan (Cradler, 1989). The CIP was written and is currently a working plan developed by teachers to target the use of technology toward the attainment of clearly defined classroom-based student and staff objectives. The CIP addresses:

1. Student needs and related instructional priorities and needs
2. Classroom-specific instructional activities to meet the needs
3. Technology-based applications to support the instructional activities
4. Individualized staff development for the teacher
5. Classroom-specific performance-based assessment methods
6. Hardware, connectivity, software, and other resources needed
7. School management commitment to ensure that the time and resources needed to successfully implement the CIP are provided for the teacher

The evaluation study showed the CIP planning process:

- *increased teacher commitment*
- *sustained increased levels of technology use*

- *improved coordination of resources for the project*
- *focused resources on the educational needs of students*
- *helped teachers determine what technology to implement*
- *provided a way for teachers to communicate about the project to other educators and to parents*

The ideal and effective school plan should be a composite of classroom plans designed to accomplish school-wide objectives. School planning that does not engage and produce classroom plans often results in school plans that are filed away and not used. Part of the school planning process must involve assisting teachers to conceptualize and develop their classroom technology plans. For details on how to design and implement school planning readers are encouraged to obtain *Destination Tomorrow: An Atlas of Technology Use in Education*, produced by the Monterey Model Technology Schools Project (see the Resources Section).

8. Staff Development. The TUP should describe the staff development and follow-up assistance necessary for successful implementation of planned activities. As teachers develop their classroom level plans the school-level staff development program can be designed. It must directly support the activities indicated in the classroom plans. The available staff development days made possible by School Improvement and School Development Plans should be allocated to support the implementation of the TUP. Research continues to show that staff development matched to the needs of the teacher is a critical factor for the success of any project. The importance of staff development was cited in the FWL study and illustrated by the comment:

> *. . ..now our teachers want more training in the use of computer programs. . . the staff development was the most beneficial and productive component of the project.*

9. Prepare an Evaluation Plan. The TUP should provide a general description of the process for evaluating the project. The process should include procedures for monitoring, implementing, collecting information of student outcomes, and assessing the effects on teaching and instructional practices. Every effort should be made to incorporate evaluation methods that are consistent with the assessment program already utilized in the school, department, and district. Most schools are adapting and devising performance-based assessment methods that mirror the instructional tasks. Many schools are adapting and devising performance-based assessment methods that mirror instructional tasks. For additional information on performance-based assessments, contact the California Assessment Collaborative (CAC) and consult the Educator's Guide for Evaluating Educational Technology Programs (see the Resources Section). Evaluation provides the necessary information to help convince a future funding agency that the project or plan is worth additional funding. Ongoing evaluation fine-tuned our program and guided the 'midcourse' corrections to keep us on target with our objectives

10. Develop a TUP budget and funding strategy. Identify adequate funding for the plan and involve the school and district administration developing the TUP budget. The TUP should provide a budget that includes sufficient funding to provide release time for teachers to implement the plan and participate in needed inservice training. The budget should describe all sources of funding ranging from the general school budget to any special grants or donations. The study showed that the least effective plans were those that did not allow enough funding for staff development and release time. Decide whether the potential technology use justifies the development of a grant application for outside funding. If the plan and its needs are clearly documented, and local resources are lacking, applying for private or public grant funding may be an option. Many sources of funding often are often overlooked. For example, many businesses are interested in forming partnerships with schools and districts to support their application of technology in the classroom. Such business should be identified early in the planning process when resources are being identified.

11. Implement, monitor, and revise the plan. If it is clear that there is sufficient interest and commitment from the school staff and the principal to provide the time, resources, monitoring, and funding needed for the proposed plan, then work with the planning committee to implement the plan. When the plan is implemented, the school site council or planning committee should provide support and monitoring of the project as it is implemented. The TUP should be viewed and treated as a part of the overall school plan and be implemented, monitored, and evaluated within the context of the existing school-based program or plan. Use the evaluation and assessment information for making mid-course corrections and to report progress to the committee, school and district staff, and other stakeholders for the project.

Within the context of the school plan, work with the committee to make necessary adjustments to the TUP that are suggested by the evaluation. Planning should be an active and ongoing process. The planning committee must provide the support and advocacy needed to maintain the interest and enthusiasm of those involved in implementing the plan. Progress of the school and classroom-level technology plans should be documented and systematically reported to the board and used as justification for requesting funding from the district, the state, or other sources.

D. Summary

This section addresses planning for the instructional integration of technology and focuses on experience and research on planning for effective integration of telecommunications into education at the school and classroom levels. The recommended implementation approach for integrating or inserting technology must focus on comprehensive planning that involves all of the stakeholders. Critical factors include establishing a vision for the plan, utilizing existing and emerging resources, basing technology decisions on curriculum and instructional needs, focusing on student needs, and providing for local staff development and follow-up assistance. This section provides a detailed and research-based model for technology use planning that should be considered. The Model emphasizes a series of operational steps for integrating technology which include: 1) establishing a stakeholder planning committee, 2) coordinating with existing plans, 3) identification of student and program needs, 4) identification of available resources to support the plan, 5) curriculum integration, 6) establishing goals and objectives, 7) developing related classroom-based plans, 8) staff development, 9) evaluation, 10) budget and funding strategies, and 11) implementation strategies.

VIII. STAFF DEVELOPMENT AND TECHNICAL ASSISTANCE

What are the most effective staff development strategies and how do these apply to building the capacity of teachers to effectively integrate telecommunications and technology into teaching?

A. National Perspective

Staff development, training, and follow-up assistance is a prerequisite for effective and sustained applications of technology and telecommunications. Educators need opportunities to acquire the skills necessary to use telecommunications and other technologies effectively. Teacher training must not only be provided for equipment and software operation, but also for teaching strategies that incorporate the use of a variety of technologies.

Consideration should be given to the enormous training challenge represented by the NII. The skills and knowledge of people using the NII should be considered as important as hardware and software. Funding for both the training of educators and the development of training materials should be provided. Recognizing the importance of staff development and technical assistance, the NCC-TET Requirement 11 is to: *Promote training, professional development, and technical assistance for educators as an integral part of the development of the NII* (NCC-TET, 1994)."

The FARNet-CoSN Forum participants viewed teacher staff development as the most important factor to consider for the effective implementation of networking in education. The Forum emphatically indicated that training and user support are essential components of any school network plan, program, or project. The mere purchase of equipment cannot guarantee the integration of networking into the classroom, and the many variations among schools and districts will require flexible approaches to training and user support. These factors should be taken into account during planning (Breeden, 1994).

First, technology integration depends upon how well training and user support focus on educational goals. Combining technology planning and instructional and organizational planning can define and achieve consistent objectives, as well as serve to educate participants in the technology planning process itself (Breeden, 1994).

A second and equally important factor is administrative support. Administrators need to provide educators with both time and incentives for adopting new technology and applying it effectively: release time, professional recognition, recognition for course work on educational technologies, and funds for attending professional meetings, symposiums, and workshops (Breeden, 1994).

Further, successful training needs to be hands-on and based on relevant examples. Local training and user support should be ongoing in order to contribute to the familiarity, frequency, and dependability necessary for effective, regular use of the technology. Trainers with a background in K-12 education will be better equipped to understand and to help educators solve real problems (Breeden, 1994). Technology training needs to be addressed to experienced educators already in the schools, as well as future teachers and administrators in preservice programs.

In addition, training for the ethical and appropriate use of networks should be provided. The predominate concern is that students do not access inappropriate information or engage in communications with adults that can be harmful. There are also concerns about violations of

copyright, protection of intellectual property, and conformance with the "acceptable use" policies of networks supported by public funds (Breeden, 1994).

B. Input on Staff Development to the National Educational Technology Plan

The U.S. Department of Education established an on-line discussion open to educators across the country in an effort to gather comments and stimulate discussion about the topics to be addressed by the emerging National Educational Technology Plan. Over 100 subscribers responded to at least one of the questions guiding the conversation. Of those participants, one-third described themselves as working in schools, primarily as classroom teachers but also as technology coordinators and administrators. One-fifth of the discussants indicated affiliation with higher education as either faculty or students. Other participants came from school districts and state departments, as well as federally-supported regional programs and various interested parties. About ten-percent identified themselves as from the private sector, often working as education consultants or in the communications industry. What follows is the summary of the responses to the discussion on Staff Development compiled by Sue Purnell (1995), an education researcher from the Rand Corporation.

This discussion on staff development ran the longest time and generated the most responses. Many subscribers used the examples of their own professional development programs to provide the lessons learned. The conversation addressed two major areas of concern: the nature of the teacher learning that needs to take place and the conditions under which professional development is most likely to succeed.

In looking at the kinds of staff development that needs to take place, many participants discussed this in the context of promoting a change in the culture of schools, some noting that technology provides tools that support a shift in the paradigm of teaching. So with technology is a tool, teachers need professional development in learning theory (styles, multiple intelligence, etc.), curriculum design, and classroom management in order to use it effectively. In support of this, many suggested that a more imbedded learning approach is most effective. A number of participants gave examples in which training on technology was linked to the development of new curriculum.

Several subscribers made the point that teachers themselves have different starting points and learning styles. Key to serving their needs is the provision of choices and options in staff development approaches and programs. Teachers are adult learners, who primarily favor individualized approaches.

Much of this discussion centered on the conditions that are needed to support the use of technology. A number of requirements surfaced over and over again to the point that a general consensus appears to exist in this area of the discussion. The conditions included the following:

- *Access to needed hardware and software.* Viewed as a precondition, many respondents argued that teachers need access beyond computer labs or kiosks that might limit usage, and therefore ownership of the process. They recommended that teachers have their own computer in the classroom and even at home, citing examples of schools that allow teachers to check out laptops or to take advantage of low/no interest loans to purchase their own computers.

- *Training and continued support.* While formal training or tutorials were considered necessary elements of professional development, everyone agreed that continued support as teachers begin actually using the technology is vital. There were strong

recommendations that the support be in the form of dedicated personnel working at the school and classroom level. Many pointed out that using other teachers to staff these positions added credibility and greater insight concerning applications to teaching and the curriculum.

- *Support of administrators.* Administrative support at all levels of the education system was viewed as key in promoting teachers' use of technology. Administrators become role models, involve other stakeholders, reward teachers who use technology, and make many of the decisions involving access and use.

- *Provision of adequate time.* A consistent theme of this whole conversation was the need to meet the time demands associated with professional development and incorporating technology into teaching. On one level this issue concerned finding time in the school day and year to attend training and then practice and apply that training to the classroom. Beyond that was the implication that the whole process of teachers learning and applying technology is a lengthy one. In many of the programs cited as examples, teachers took several years to reach that objective, often attending work sessions over several summers.

Finally, several contributors flagged two issues that need to be addressed in other discussions. First, several rural participants noted the relative isolation of teachers who had little or no telecommunications capability either at school or at home. It was noted that several rural states had created statewide networks in response to that need, but that for teachers in many rural areas affordable access is still a problem. Second, participants suggested that this question also should be applied to pre-service faculty. They expressed disappointment that colleges of education have not paid more attention to this issue especially since the faculties often are themselves resistant to incorporating technology in their own teaching.

C. Current Status of Teachers and Staff Development for Technology Use

The OTA comprehensive study of teachers and technology emphasized staff development, teacher preparation, and support needed to build teacher capacity to effectively integrate technology and telecommunications into teaching. Following is a summary of the findings of this study.

- *Most teachers have not had suitable training to prepare them to use technology in their teaching.* A majority of teachers report feeling inadequately trained to use technology resources, particularly computer-based technologies. Although many teachers see the value of students learning about computers and other technologies, some are not aware of the resources technology can offer them as professionals in carrying out the many aspects of their job.
- *In a majority of schools, there is no onsite support person officially assigned to coordinate or facilitate the use of technologies.* Even in schools where a technology coordinator exists, most of the time is spent supervising students or selecting and maintaining software and equipment. Very little time goes directly to training or helping teachers use technologies.
- *To use technology effectively, teachers need more than just training about how to work the machines and technical support.* To achieve sustained use of technology, teachers need hands-on learning, time to experiment, easy access to equipment, and ready access to support personnel who can help them understand how to use technology well in their teaching practice and curriculum.

- *Schools and school districts are using a number of different approaches for training teachers and implementing technology.* Various training approaches include developing "technology-rich" model schools; training a cadre of teachers who train and help their colleagues; providing expert resource people; giving every teacher a computer; training administrators alongside teachers; and establishing teacher resource centers. Data does not confirm that any one strategy is more effective than another; often they work in combination. Districts may be well advised to use multiple training and support strategies tailored to the educational goals of the local site.
- *Lessons from experienced implementation sites suggest that those who wish to invest in technology should plan to invest substantially in human resources.* Currently most funds for technology are spent on hardware and software. Increasingly experienced technology-using sites advocate larger allocations for training and support.
- *Support for technology use from the principal and other administrators, from parents and the community, and from colleagues can create a climate that encourages innovation and sustained use.*
- *Schools should avoid acquiring technology for technology's sake.* Developing a technology plan -- thinking through the goals for technology use at the local site and involving teachers in the planning process -- is an important step in ensuring that the technology will be used by those it is intended to support. Many districts have found that it works best to start with small focused efforts, which can engender lessons, success, and experience before committing to more large-scale programs.
- *Although sites have made significant progress in helping teachers learn to use generic technology tools such as word processing, databases, and desktop publishing, many still struggle with how to integrate technology into the curriculum.* Curriculum integration is central if technology is to become a truly effective educational resource; yet true integration is a difficult, time-consuming, and resource-intensive endeavor. Research funding is needed to help explore and develop technology tools best suited for specific curriculum areas, especially disciplines other than science and math (OTA, 1995).

D. Barriers to Staff Development

The OTA finds that helping teachers use technology effectively may be the most important step to assuring that current and future investments in technology are realized. A majority of teachers report feeling inadequately trained. Some are not aware of the resources technology can offer them as professionals in carrying out the many aspects of their jobs. Integrating technology into the curriculum is central if technology is to become a truly effective educational resource. The OTA study reports that most teachers have not had adequate training as districts, on average devote no more than 15% of technology budgets to teacher training. Some of the major barriers and issues related to teacher development and support are:.

- Many teachers lack a clear understanding about the resources technology and telecommunications can offer when used as an instructional tool.
- Many teachers encounter technical and logistical problems and often lack the training and support necessary to resolve the problems.
- Many feel the need for more knowledge -- not just about how to run the machines -- but about what software to use, how to integrate it into the curriculum, and how to organize classroom activities using technology.
- The current assessment system, if it relies heavily on standardized achievement tests, can also be a barrier to experimentation with new technologies because teachers are not sure whether the results they are seeking will be reflected in improved student test scores.

- Issues created by technology itself are also factors to be dealt with, including those related to copyright and intellectual property rights, privacy of student records, and control of student access to objectionable materials (OTA, 1995).

E. Some Promising Approaches for Staff Development and Technology Implementation

The challenge of integrating technology into schools and classrooms is much more human than it is technological. It is not fundamentally about helping people to operate machines. Rather, it is about helping people, primarily teachers, integrate these technologies into their teaching as tools of a profession that is being redefined through the . . . process (Means, 1993).

Some schools and colleges of education are developing approaches to technology implementation from which others can benefit. The approaches differ, depending upon the existing resources (human and technological) at a site, the visions the sites have developed for how technologies are to be used and what problems they can address, and the leadership and support to meet those goals. These approaches include the following:

- developing technology-rich classrooms, schools, or districts in which local expertise in various applications of technology can be developed and shared;
- training master teachers, who then serve as resources for their colleagues;
- providing expert resource people from other staff, such as librarians, computer coordinators, or volunteers from business, parent, and student groups;
- giving every teacher a computer, training, and time to develop personal confidence and expertise;
- training administrators so they can serve as technology supporters and guide efforts within their schools or jurisdiction; and
- establishing teacher or technology resource centers, ideally with ease of teacher access through online services.

Most schools combine several of these approaches, and there is no clear evidence that any one model is more successful than others.

F. The Need for Follow-up Technical Assistance

Typically, formal training sessions in the uses and mechanics of educational technologies provide only the basic knowledge that gives teachers an impetus to further experiment. Teachers consistently report that having a person at the school site who can help them, makes the difference in the likelihood of their further utilizing technology -- someone who is knowledgeable about technologies and can help with questions or problems. For example, when asked what one factor would help decide whether and how to use a computer, one teacher replied:

> *If I could have a few hours one-to-one with a really competent teacher that has used it -- just let me ask questions [about] what I'm afraid of about a computer, what I don't understand* (Schofield).

Inevitable technical and logistical problems that arise with technology are the reasons many teachers feel the need for onsite assistance. Teachers can encounter such problems as machines

that won't work as promised, restricted access to locked closets filled with equipment, media carts that must be scheduled and shared among many classrooms, equipment that remains broken for weeks or even months because no one knows how to fix it and repair requests may take that much time to process. For example, one teacher who had to coordinate computer use with others in her grade, said that she would rather not have the computer than to "scuffle around the school" looking for it. It had become a "pain," rather than an asset to the classroom (OTA, 1995).

G. Telecommunications and Professional Development

1. Research on technology to support professional development. Educators are using telecommunications for professional development activities. The Center for Technology in Education Study (Honey, 1993), found that collegial exchanges, including communicating via e-mail to colleagues and posting questions or exchanging ideas on forums and bulletin boards, are the services most frequently used for professional purposes. Information retrieval services are also widely used, including databases that contain information relevant to students and databases of educational research. In contrast, networks are used less frequently for administrative tasks such as planning, scheduling, or reporting on meetings, and student progress. The network services that are most frequently used for professional purposes are also rated as the most effective.

> *Working as the only computer specialist in the school and district, it is invaluable to me to have contact with other professionals using computers in new and innovative ways. Informal questions can be asked. Help can be received in an inexpensive way. Discussions on software, equipment, and programs can be generated* (District Computer Specialists).

Educators report a range of incentives for using telecommunications as a professional resource. Networking activities play a critical role in relieving the isolation that is a familiar experience for many teaching professionals. Educators view the opportunity to communicate with other educators and share ideas as one of the major benefits of this technology. Obtaining rapid feedback on curricular issues and other topics of professional interest, and keeping current on subject matter, pedagogy, and technology trends are also important incentives. Educators do not feel that telecommunications is too time-consuming to function effectively as a professional resource. In fact, a great number are using information services and conducting collegial exchanges on an average of once a week or more. Further, professional networking activities are increasingly being conducted from homes, suggesting that much work is now done on their own time, at their own expense, and with a high level of commitment. Nearly three-quarters of the Center for Technology in Education sample have a modem in their homes.

> *I have been able to meet and work and learn with such a variety of educational professionals that it is rather like being in continuous attendance at a large international conference* (High school science teacher).

2. National online discussion on technology for staff development. The U.S. Department of Education on-line discussion for the National Educational Technology Plan asked: *How can technology itself be used to help teachers learn?* The discussion of this question included a number of ways technology could be used to increase access to professional resources and facilitate learning.

Some participants highlighted the relative efficiency and time-saving opportunities provided by technology. There will be more time for learning if teachers have software that frees them from paperwork or distance learning technologies that eliminate the need to travel. In some cases

technology not only changes the way the task is completed, but also changes the tasks themselves.

Many participants noted that technology helps teachers learn by increasing access to many more sources of learning. The ability to attend conferences, share with other teachers, or research the education literature from the teachers' own classroom or school provides more opportunities for professional development. A number of participants gave examples of these opportunities, including taking courses on-line, exchanging information via teacher bulletin boards, e-mail and video conferencing.

H. Staff Development Guidelines Applied to Technology Use

The *National Staff Development Council* recently completed a comprehensive study of what has been learned about staff development for the past 20 years. From this study, NSDC developed a set of guidelines for the development and implementation of staff development. These guidelines should be applied to the development of teachers' capacity to implement any educational innovation or initiative, including the educational application and integration of technology (Sparks, 1994).

Rather than receiving "knowledge" from "experts" in training sessions, teachers and administrators should collaborate with peers, researchers, and students to make sense of the teaching/learning process in their own contexts. Staff development from a constructivist perspective would include activities such as action research, conversations with peers about the beliefs and assumptions that guide individual instruction, and reflective practices such as journal keeping and other activities which many educators may not even view as staff development. These and other educational reforms have produced profound changes in how staff development is conceived and implemented. The following table represents some of the most important of these changes:

General Guidelines for Effective Staff Development

- *From individual development to individual development and organization development.* Researchers estimate that 85% of the barriers to improvement reside in the organization's structure and processes, not in the performance of individuals. Unless individuals learning and organizational changes are addressed simultaneously and support one another, the gains made in one area may be canceled by continuing problems in the others.
- *From fragmented, piecemeal improvement efforts to staff development driven by a clear, coherent strategic plan for the school district, each school, and for the departments that serve schools.* School improvement too often has been based on fad rather that a clear, compelling vision of the school system's future. This, in turn, has led to one-shot staff development workshops with no thought given to follow-up nor how this technique fits in with those that were taught in previous years.
- *From district-focused to school-focused approaches to staff development.* More learning activities are designed and implemented by school faculties, with the district's staff development department providing technical assistance and functioning as a service center to support the work of the schools.
- *From training that one attends from the job as the primary delivery system for staff development to multiple forms of job-embedded learning.* Critics have long argued that too much of what passes as staff development is "sit and get" in which educators are passive recipients of received wisdom Staff development should incorporate such diverse means as action research, participating in study groups or small-group problem solving, observing peers, journal writing, and through involvement in the improvement planning processes.
- *From staff developers who function primarily as trainers to those who provide consultation, planning, and facilitation services, as well as training.*

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General Guidelines for Effective Staff Development

- *From staff development provided by one or two departments to staff development as a critical function and major responsibility performed by all administrators and teacher leaders.* Job-embedded staff development means that superintendents, assistant superintendents, curriculum supervisors, principals, and teacher leaders, among others, must see themselves as teachers of adults and view the development of others as one of their most important responsibilities.

- *From teachers as the primary recipients of staff development to continuous improvement in performance for everyone who affects student learning.* To meet the educational challenges of the 21st Century, everyone who affects student learning must continually upgrade his or her skills, school board trustees, superintendents and other central office administrators, principals, teachers, the various categories of support staff (e.g., aides, secretaries, bus drivers, custodians), and parents and community members who serve on policy-making boards and planning committees.

- *From staff development as a "frill" that can be cut during difficult financial times to staff development as an essential and indispensable process without which schools cannot hope to prepare young people for citizenship and productive employment.* Both the development of school employees and significant changes in the organizations in which they work are required if schools are to adequately prepare students for life in a world that is becoming increasingly more complex.

National Staff Development Council, 1994

I. A Flexible Model for Training and User Support

All of the groups in the CoSN-FARNet Project acknowledged a clear and overwhelming need to include training and user support as part of any school networking plan, program, or project. This consensus underscored a common belief that the purchase of equipment is not a guarantee of successful integration into the classroom. In the words of the Finance discussion group, "Curriculum development costs, teacher training costs, and hardware purchases are equal pieces and must be considered simultaneously." Practitioners must be trained in the practical use of technology and supported in an ongoing, long-term manner. The many variations among schools and districts will require different approaches to training and user support. Nonetheless, certain factors should be taken into account in any plan (Breeden, 1994). These include:

1. Technology Integration: The compelling reason for the introduction of any educational technology must be that the technology will enhance teaching and learning. The focus of any training or user support program must also be to support educational goals. It is recommended that technology planning be closely integrated with instructional and organizational planning, so that consistent objectives can be defined and achieved. This approach carries the added benefits of educating the participants in the planning process, building a common "database" of information, and saving scarce education dollars.

Technology, in general and networking, in particular, have the potential to change existing habits and patterns. But it must first address specific local educational needs. Over time it may -- and in fact probably will -- enhance the system, but it cannot work in ignorance of, or in isolation from, the schools as they are today.

2. Management Support -- Incentives and Time: Educators, like other professionals, are busy people. Managers can support the introduction and use of new technologies by providing release time, professional recognition, and in some cases financial compensation to staff who are learning how to network. Network-based activities place new requirements on teachers: learning how to use the computers and software, incorporating networked resources into the curriculum, and guiding many independent student projects. The main work force in education

requires signs from management that the adoption of new technology and its effective application are considered significant aspects of professional accountability and development.

Time is an essential factor in training and user support. Teachers typically have little free time during the school day to learn to use new technologies, and even less time to train their students. Networking brings added time demands, in that using the new technology may require curriculum development and integration into current programs of study.

3. Components of Successful Training and Support: Successful training is an ongoing process, and as such becomes part of user support. Because technology is constantly evolving, most users will benefit from regular, confidence-building updates. The most successful training for educators involves direct, hands-on experience with relevant examples and real products made by others in education. Training that models the behavior and illustrates the adoption of the technology is critical to success. Incentives need to be created that will provide for these models.

User support must be reliable and consistently available. If it is not, the time pressed educator will become frustrated and may abandon the use of the new technology. In general, the more local the training and user support, the more effective. Familiarity and dependability are also critical factors. If training is conducted in an unfamiliar setting, it will be more difficult for the educator to adapt the new technology to the local setting. If user support is too far removed from the building and if support staff are not frequent visitors, busy educators will be less likely to continue to use the new technology on a regular basis, particularly if they experience any snags that are not resolved swiftly.

Staff who train and support educators must have some K-12 background or, at least, a good knowledge of the environment. Educators respond best to people who are sensitive to the unique pressures of the profession and are able to offer assistance in solving real problems. User manuals should be concise, plain, and clear, and should include examples that focus on the local system and practical educational uses.

The need to train experienced practitioners who are already in the schools is of major importance and will for the most part be satisfied through innovative inservice training programs. These programs should have built-in models for follow-up and support. Educators should also be given support and recognition for course work on educational technologies and funded to attend professional meetings, symposiums, and workshops.

Post-secondary teacher training programs should also begin to develop courses on advanced technologies and applications and should work with business schools to develop courses of study geared to potential managers in education. It is critical that networking be introduced to a new generation of teachers not yet in the classroom, which will reduce inservice training costs.

J. What the Experts Have to Say About Staff Development and Technology Integration

As part of the Telemation Project, a survey of nationally recognized spokespersons was conducted for the purpose of ascertaining effective ways of developing the capacity of teachers to effectively integrate networking technology into teaching and learning. This information was used to help inform the development of the Telemation training curriculum used by the California State Telementors (FWL, 1995). The survey sampling includes eighteen representatives from throughout the United States who were contacted by phone and asked to respond to questions concerning effective ways of integrating the use of telecommunications into

teaching and learning. Telecommunication was defined as computer-based information systems utilizing modems hooked up to computers, which allow communication to take place over telephone lines. Answers were collapsed into responses of similar kind. A brief summary of the responses to each question follows.

1. From experience, what is the most effective way to teach teachers to use telecommunications? In general, all respondents reported that the most effective staff development for effective teacher-use of telecommunications must, at a minimum, incorporate the following guidelines:

- Provide training in small groups or on a one-to-one basis
- Utilize a 'hands on' experimental approach to training
- Make sure that telecommunications activities are relevant to curriculum
- Allow teachers to find the "personal value" that telecommunications has to offer
- Provide training in small steps to maximize successful experiences
- Ensure that the teachers have easy access to the network before training begins
- Target the use of telecommunications to relevant teaching activities

All respondents generally viewed well planned training as essential for teachers to be able to use telecommunications effectively. They all felt that training should be experiential, practical, and as relevant as possible to the teachers instructional and classroom management needs. They felt that only with sufficient training can teachers access and make effective use of the information highway.

2. What are some of the better models to use when teaching teachers how to integrate telecommunications into their curriculum? Respondents identified models based on their collective experiences with the most effective ways for teachers to integrate telecommunications in the curriculum. The following represents the consensus of their responses:

- Provide for a district-wide telecommunication-integration training plan
- Establish opportunities for teachers to support and train others (peer teaching)
- Training models should provide for personalized follow-up
- A cadre of telecommunications trainers should be available to teachers
- Telecommunications using teachers should have an opportunity to communicate experiences
- Model programs should have strong leadership
- The most effective models have a shared vision and a strategic plan

In general respondents feel that we should continue to identify and utilize models that already exist rather than constantly re-inventing the same ones. A communications system that supports training in the integration of technology into the curriculum should be established to support sharing of models for teachers to follow.

3. What are some of the more important resources used to help people with telecommunications? Respondents in the phone interviews noted the increasing use of telecommunications by educators and students to connect with each other and access the vast array of information resources to be obtained online. E-mail, chat-lines, forums, news access, and databases are just a few of the online resources being used to enhance their classroom teaching. Some of the respondents mentioned the importance of statewide networks, such as California Online Resources for Education (CORE), the Texas Education Network (TENET), and local bulletin board services (BBS), in accessing the Internet and obtaining useful educational resources. Interview participants also pointed out the importance of using professional organizations and support agencies, such as the California Technology Project and Computer-Using Educators. In addition to maintaining an online presence and information

source, such organizations provide technical assistance and support for teachers' use of telecommunications.

4. What kind of time and local commitment is needed for successful telecommunication implementation? Support for teachers is critical for the effective use of telecommunications in teaching and learning, and respondents noted the importance of both district and site level commitment in the following ways:

- District and site level technology coordinators to support classroom teachers
- Develop strategies and provide assistance that can help teachers deal with information overload
- Provide financial support for classroom connectivity, hardware, and staff development
- Work with teachers to ensure time for training and practice
- Support telecomputing at home

Interview respondents noted that time for educators to practice in the use of networking is the greatest challenge and referred to an emerging role for the librarian and/or site-based computer coordinator to relieve some of the timing constraints on the classroom teacher.

5. What are some of the better ways to integrate telecommunications into curriculum? Respondents stressed the importance of teachers and staff having equitable access to telecommunications and information on the support resources to be obtained through networking, such as examples for instructional applications, development of instructional materials, and research that can be applied in the classroom. Respondents noted that for telecommunications to be effectively integrated into curriculum, teachers must be aware of:

- The relevance and usefulness of telecommunication resources to their classroom instruction
- The use of telecommunication networking as a vehicle for communication and information and resource sharing among peers
- The use of networking resources in support of curriculum frameworks and tied into a constructivist approach to learning
- How the telecommunications can be utilized in projects that engage students in real-world activities and link teachers and students with real-world actors

Interview respondents, again, noted the importance of teacher support, for instance having "hunters" (librarians/computer coordinators) to locate information relevant to current classroom topics. In turn, this research can lead to the creation of a new classroom resource that may be shared among peers.

6. In what way is staff development for integrating telecommunications into the classroom different from regular staff development (unique challenges)? In general, interview participants said that successful staff development strategies *should* apply equally for all school programs, and essential elements of staff development should be the same, whether providing training in telecommunications usage or how best to provide educational services for the at risk student. However, respondents pointed out a variety of differences in training specifically for the integration of technology and telecommunications into curriculum, such as:

- Training in telecommunications requires a hands-on approach
- Developing a "personal value" in regards to telecommunication use
- "Break the mold" staff development strategies are key
- Learning to use telecommunications will require "at home" practice

Experts questioned in these interviews noted the importance of developing goals that can be attained in a reasonable time frame with the resources available. Some of the respondents recognized that while it's not important for the entire staff to support telecommunications usage, it is important to initiate pilot "telecommunications" projects that are consistent with a school's overall educational plan.

7. What guidance should a telementor be advised to do while training. The following represents the consensus of the experts on "tips" for conducting training. They stated that Telementors should:

- Proceed slowly
- Advise teachers of ways to deal with Internet information overload
- Conduct short activities that have a beginning and an end
- Introduce the Internet by having teachers use it for their personnel and professional interests
- Be neutral about your values as a trainer
- Honor the knowledge of your learner

It is important to read the audience before you begin, meet their needs, aand be sensitive to peoples' fears of technology. Assure the teachers it's o.k. to be fearful and try to identify and work through their individual concerns.

8. What would you advise a telementor <u>never to do</u> while training? The following are among the most relevant comments about what <u>not</u> to do: tell them that what they're using is "cool"; talk down to people, provide "one-shot" training without follow-up; make it sound like "anybody" can do it; act like what you're doing is self-evident; use the "I'll show you" model; present the technology as a solution independent from pedagogy; set expectations teachers can't meet when they return to their school.

9. What are some of the better ways to provide <u>follow-up</u> or support to telementors? Among the follow-up strategies suggested were: establish a "buddy" mentor on-line; communicate on-line; get together every six months; provide a newsletter with "Tips for Success"; set up a telephone help desk - 800#; bring the human network together for time to reflect and share - telecommunication is all about "linking"; provide free hours on-line at home; provide take home staff development videos.

10. What features help to <u>sustain positive training experiences</u> while working with teachers? Comments about positive training features that teachers should be provided with included: knowledge of on-going district office support; stipends when possible; recognizing that everyone needs to be a beginner; minimal "techy" jargon; knowledge that telecommunications can "breakdown" the barriers; ways to actively involve students in projects; networks that enhance a sense of "community"; opportunities to work through their interests.

11. How would you <u>evaluate or assess</u> the instructional use of telecommunication and its impact on students? The experts advised the following as possible assessment techniques for determining the impact of telecommunication resources on students: student projects, products, and portfolios; monitor on-line usage; Likert-scaled questionnaires for teachers; report teacher enthusiasm about discovered resources; improved student attendance; increased student interest in "education"; student enthusiasm about subject matter; follow-up surveys on why people are not using telecommunication, monitor time on task, and survey attitudes of teachers/ administrators on how telecommunication usage is changing their role; survey attitudes of students about learning; and survey attitudes of parents about their students' involvement with telecommunications.

General comments by the 'experts'. It must be remembered that the majority of teachers in classrooms today have been teaching for more than 15 years; they have developed teaching practices well before the advent of the microcomputer. Computers weren't part of their experience as learners, either in their K-12 schooling or in their collegiate pre-service education. While this is a major challenge that the education community has to confront, an even bigger challenge is how to evaluate the impact of technology, more specifically, telecommunications, in the teaching and learning environment. How do you know if the cost and time are worth it? Aggressive district leadership is needed to meet these challenges. Districts need to develop evaluation models designed specifically to measure the impact of telecommunications in teaching and learning. An evaluation model should be both qualitative and quantitative, measuring not only the effects on students, but on teachers, classroom practices, and the families and home life of students as well. The following chart provides the summary of the recommendations from the 'experts' (See Appendix D for a listing of the survey participants).

What the 'experts' say about staff development and educational networking

1. The use of telecommunications as a tool for learning is, at best, one that has limited acceptance and usage in the current teaching and learning environment.
2. Factors such as cost, networking, and staff development impact this limited usage.
3. Visionary and aggressive district and/or school leadership has the greatest influence as to whether or not telecommunications is integrated into the school/classroom environment.
4. Teachers involved in the integration of telecommunications in their schools are involved in an educational paradigm shift, and as such, need to understand how this change process is impacting their teaching and learning environment.
5. Districts and schools that have educational technology plans seem to integrate telecommunications into the teaching and learning environment more easily than those that do no have educational technology plans.
6. Successful staff development for telecommunications integration include: release time, access to equipment, remuneration, modeling by peers, hands-on, relevancy to the curriculum, pilot projects.
7. There is no common agreement as to how the impact of telecommunications usage in the classroom should be evaluated.
8. Collaboration between users of telecommunications promotes sustained curriculum integration efforts.
9. There is an adequate number of software applications and interfaces to support teachers' efforts to integrate telecommunications into their curriculum.
10. Teachers using telecommunications as a tool to support their curriculum instruction spend the majority of their on-line time at their own residence.

Far West Laboratory, 1994

K. Involving Administrators in Staff Development

Research on the adoption of innovations in schools consistently points to the key role of administrative leaders in successful implementation. Involved and supportive superintendents are central to district-wide reform efforts, and principals are key to implementation within the school building (OTA, 1995). OTA has consistently found that when administrators are informed about and comfortable with technology, they become key players in leading and supporting technology integration activities in their schools (OTA, 1988). Some technology

implementation efforts are building on these lessons by including principals or other key administrative staff in training opportunities offered to teachers.

One approach is to include principals in school-based teams chosen to receive intensive training in technology use. For example, the Apple Classroom of Tomorrow Teacher Development Center Project looks at the commitment of the principal when selecting teacher teams for training. Not only are principals encouraged to attend portions of the training program with the teacher team, but they also must commit to the following conditions: release time for teachers to attend project training sessions, time for teachers to meet and plan each day, time for teachers to reflect on practice, and acknowledgment of the importance of their teachers' efforts to the rest of the staff.

Since 1990, Indiana has sponsored a statewide training program specifically for principals. In its first two years, the Principals' Technology Leadership Training Program served almost 400 Indiana principals. Over the course of a year, each principal takes four days of professional training with other principals at a central site. By scheduling sessions at different points in the year, the program built in time for principals to go back to their schools, practice what they learned, and talk to staff and better define staff needs and wants. In the workshops, principals learned about a broad range of technology and software available for classroom and office ues and had a chance for hands-on exploration of a large collection of equipment.

Participating principals have been very enthusiastic about the Technology Leadership Program. In addition to reporting that they felt more confident and credible in dealing with technology, and better able to use technology for administrative tasks, participating principals said they were more capable of creatively using capital project funds, writing grants, or justifying expenditures to school boards. After the training, many principals conducted training for their teachers; others reported that they were better equipped to think comprehensively about the technology in their schools and how best to use it. Principals rated an update session held the following year, as very valuable, and most principals endorsed the need for some kind of ongoing "refresher programs."

Although there are no systematic data on the effects of training principals, the Apple Classroom of Tomorrow (ACOT) and Indiana examples demonstrate the feasibility and importance of enlisting principals in the diffusion of technology in schools (Dwyer, 1994).

L. Overview of Teacher Support Factors for Effective Technology Integration

The overall findings of this analysis supports specific school and district level program characteristics needed to enable teachers to effectively utilize technology. Such factors generally include:

- Teacher-awareness of effective technology applications
- Time for teachers to plan, learn about, and implement technology applications
- A social network of other technology-using teachers.
- Availability of teacher-mentors or other peer support
- Involvement of principals and other administrators in the planning and training
- Development of the knowledge to critique and select technology applications
- Development of school and classroom level technology plans by and for teachers
- Involvement of teachers in deciding classroom uses of technology

- Teacher-access to technology while planning
- Understanding of ways to integrate technology into education reform
- Preparation of new teachers for effective integration of technology into teaching
- Long term staff development to support integration of technology into instruction
- Increased opportunity for staff development and technical assistance
- Access to technology and telecommunications resources
- Awareness of and access to educationally relevant technology-based programs
- Equitable access to centralized information resources related to technology use
- Teacher- and student-access to computers outside of school
- Opportunities for educators to communicate with peers in other schools and at conferences
- School and district administrators committed to the use of technology

M. Summary

This section addresses staff development to support technology integration and provides information about effective staff development strategies to help build teacher-capacity to integrate telecommunications into education.

A comprehensive review of the literature, along with interviews of educational technology leaders, pointed out several factors to consider when establishing a staff development program for telecommunications applications in education. In general these include features that are usually cited for staff development, including: 1) staff development driven by clear and local needs of teachers, 2) emphasis on hands-on experience -- especially for technology use training, 3) emphasis on peer coaching rather than lecture format, 4) integration of staff development for technology into other staff development programs in the school and district, 5) involvement of administrators as participants with teachers in technology staff development, 6) provision for the release-time needed for teachers to apply what they learned in training, 7) follow-up support for implementation of technology skills learned in training, 8) access to the needed resources to support teacher-implementation of what was learned in staff development sessions, and 9) use of telecommunications access for teachers to communicate and share their experiences in using technology.

For planners it is important to budget at least 25% of the educational technology program or project budget for staff development and technical assistance. It is even more important that ongoing staff development programs include applications of technology and telecommunications to support current and new instructional strategies.

57

IX. CLASSROOM APPLICATIONS AND EXAMPLES

What are some examples of the most effective uses of telecommunications and the resources accessed for teaching and learning?

A. Bringing New Resources into the Classroom

Telecommunications creates broad possibilities for transcending school walls and accessing a wide range of learning opportunities and resources. Today, computers with modems, telephone lines, and local or wide area networks enable teachers and students to explore worlds beyond their immediate reach, such as perusing the card catalog at the local library for a list of books on a research topic, sharing weather data with scientists on a network, or previewing software to see if it is appropriate for a particular grade level.

Many of the teachers who access telecommunications networks do so after school or at night, on their own time and very often at their own expense; but they say it is worth it. For instance, a teacher in Arlington, Virginia, said that she pays for her subscription to America Online because communicating with a scientist at a national research lab is a great way to get ideas for student projects or to encourage students in their work (OTA, 1995).

Teachers who use telecommunications resources particularly mention the ways it can "extend the learning environment" for students (Frazier and Frazier, 1994):

- *Electronic networks bring real equality of education to all students. My inner-city students were learning and participating with private school students who have access to very specialized equipment. Through Internet, my students were unaware of the social status of these students. It was wonderful to watch them exchange scientific information with students they would be very uncomfortable with in a classroom.*
- *It has expanded our classroom . . . removed the walls . . filled us with a sense of possibility . . . made us less provincial . . . personally involved us with the nation and the world.*
- *We're more keenly aware of a world outside the classroom, in the sense of being able to reach out to information resources and not operate in a vacuum.*

The Center for Technology in Education national survey of telecommunications and K-12 educators showed that at the school and classroom level, the educators surveyed are taking the initiative for telecommunications activities in their schools, acting as facilitators and resource people for their colleagues. In the majority of cases these educators were the principal catalysts for their schools' involvement with telecommunications. Approximately half of the educators reported that when there is continued on-site support for telecommunications activities in their schools, it comes from school or district specialists, or most often, from other teachers. Financial support for telecommunications tends to come from either school or district funds rather than state or federal funds (Honey, 1993).

Telecommunications can connect students and teachers -- sometimes instantaneously and simultaneously -- to poets or politicians, musicians or religious leaders, university professors or researchers on a national supercomputer, or other students down the block or on the other side of the world. The number of these telecommunications-based activities is growing rapidly, in part because of teacher and student enthusiasm for the opportunity to collect, share, and evaluate their

ideas, data, and writing with classes in other schools and states or even in foreign countries. Some of these links are initiated by individual teachers on a class-by-class basis.

Increasingly, telecommunications-using teachers are finding that connecting to a "listserve" gives them immediate access to classes sharing a common interest in a particular topic. For example, "GLBL-HS" is a listserve created by two New York teachers for teachers and their students interested in discussing world cultures (Rutowski, 1994). Another listserve, called the "Noon Project," involves classes at different latitudes where students measure the shadow of a meter stick at noontime. Based on these measurements and the latitude of each site, the classes calculate the diameter of the earth (TERC, 1994).

There are also a number of more extensive curriculum-based telecommunications projects using electronic networks. While many teachers have long used project-based teaching and continue to do so without technology, many teachers are enthusiastic about what technology can add by extending the project beyond the classroom. These projects have typically been created with federal or private support to cover the costs of curriculum development, organization, and teacher support.

Some projects, such as the AT&T Learning Circle, KidLink, and the International Poetry Guild, center around writing and the humanities. However, most projects focus on science and mathematics, such as Global Lab, an environmental education curriculum primarily for students in junior high and high school; the National Geographic Society's Kids Network, which presents science topics to upper-grade elementary school children; Kids as Global Scientists, in which elementary school students around the world exchange, compare, and study weather data with each other and mentors; and the Weather Underground, a similar weather study project linking students throughout Michigan. Projects such as these can supply the focus and boundaries for interaction and can provide teachers with the content, accompanying materials, organizational help, and technical assistance they may need to work telecommunications into their curriculum and lesson plans (OTA, 1995).

B. Studies on Barriers to Using Technology in the Classroom

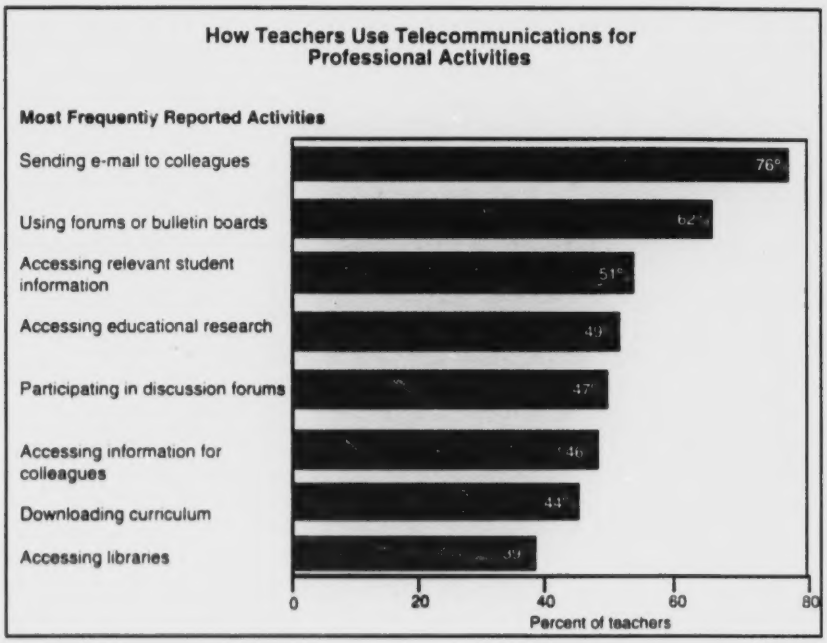
The Center for Technology in Education study reported that all of the teachers surveyed faced at least some barriers as they tried to integrate computers into their teaching. The barrier most often cited by teachers was the lack of time to develop lessons that used computers. Other significant barriers mentioned were problems with scheduling enough computer time, too few computers for the number of children, too few printers or other peripherals, inadequate financial support, and not enough help for supervising student use of computers. Other frequently mentioned barriers to effective telecommunications use included insufficient telephone lines, inadequate communication about school and district telecommunications activities, and lack of funds to cover the cost of network services (Hendriquez and Honey, 1993).

C. Local Implementation of Telecommunications

The Center for Education in Technology study found that more than a third of the teachers surveyed reported that they served as telecommunications resource staff and facilitators for their colleagues. Approximately one quarter reported that they were the sole users of telecommunications in their schools; another quarter reported that several teachers in their schools used telecommunications for activities unconnected with each other. Only one tenth of the respondents reported collaborating with other teachers in their building on

telecommunications activities. More than half of the respondents described themselves as the principal catalyst for their schools' telecommunications activities.

The figure below shows that communications via e-mail is the most popular use of telecommunications networks. The chart that follows the figure provides more complete data on the survey. The study also reported on the teachers' typical use of telecommunications in the classroom. However, this may have changed with the more recent access and use of the Internet as an educational resource.



How Teachers Use Telecommunications: Results of a Survey of Teachers
who are Telecommunications Pioneers

To understand better how telecommunications resources are being used in schools, in 1993 the Center for Technology in Education undertook a survey of K-12 teachers actively involved in using telecommunications. To find such a group, they posted online announcements on more than 50 educational, commercial, and state-run telecommunications networks. They also solicited respondents through mailing lists, conferences, state education departments, and professional contacts. Of those teachers who were contacted in this manner, 550 completed questionnaires.

The teachers who responded were an experienced group (83 percent had been teaching for 10 or more years) and were heavily concentrated in jobs directly related to using technology in instruction, such as computer specialist or library media specialist. Most (82 percent) of the respondents reported using computers in their teaching for five or more years; on average they had been using telecommunications for professional reasons for more than four years. Almost all (91 percent) had access to a computer at home; 73 percent had access to a modem at home.

Teachers were surveyed about the kinds of professional activities for which they used telecommunications. The most frequently reported activities were those used for collegial exchange, including sending e-mail to colleagues (76 percent of teachers reported doing so) and posting questions or exchanging ideas on forums and bulletin boards (62 percent). A substantial number of teachers also reported using telecommunications for information retrieval, such as accessing databases that contained information relevant to students (51 percent) and databases of educational research (49 percent), downloading curriculum materials (44 percent), accessing libraries (39 percent), and accessing information for colleagues (46 percent). A quarter of the teachers responded that they used telecommunications for one of these functions every day. Fewer teachers reported using telecommunications for administrative tasks, such as planning meetings (34 percent) and obtaining schoolwide information (18 percent) or attendance records (8 percent). This may be because many of the schools in which these teachers worked did not have the network infrastructure needed to perform such schoolwide functions. For example, 45 percent of the schools did not have a local area network (LAN), and 43 percent of those with a LAN reported that it was restricted to one room. Teachers were also surveyed about the most frequent uses of telecommunications for student learning, which were less regular than teacher professional uses. The most frequently cited activities involved students' accessing services and databases, including encyclopedias (57 percent of teachers used them with students), news retrieval services (54 percent), weather information (50 percent), Educational Research Information Center (ERIC) and other educational databases (48 percent), and scientific databases (39 percent). Classroom exchange projects were the other major use of telecommunications with students; these activities included pen pal exchanges (41 percent of teachers reported using these), scientific data collection and (about 7 percent) reported using telecommunications activities with students on a daily basis (OTA, 1995).

*The authors of the study report that "across size, type of school, and ethnic and economic representation, the schools in our sample are comparable to national averages. Although there is a trend toward more suburban schools in our sample than is the case nationally, our economic data suggest that our sample does not represent more affluent communities. In fact, the percentage of schools which report that their students receive free or reduced price lunches is slightly greater in our sample as is the case nationally.

D. Using Computer Networking for Learning

1. Examples of schools making effective use of computer networking. The U.S. Office of Educational Technology in building its resource homepage has been collecting examples of exemplary applications of telecommunications to support teaching and learning. Following are some of the examples of this growing collection:

- At Centennial High School in Champaign, Illinois, high school students design their own science experiments. For example, they add and subtract ions to atoms and watch the results.
- At Christopher Columbus Middle School in Union City, New Jersey, school and homes are linked.
- At Pease Middle School in San Antonio, Texas, a chemist helps students discover the cause of poor-quality air in their middle school.

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- In Pittsburgh, Pennsylvania, foreign language students in the public schools write messages in Spanish, French, and German to students in other countries.
- At the Florida School for the Deaf and Blind in St. Augustine, Florida, students who are blind explore information resources and communicate with people in the community through a local bulletin board.
- Using Internet access at public and school libraries through the Maryland Sailor project, students at a technical high school tap into statistics from the U.S. Department of Commerce to create career plans.

All these efforts have one thing in common: telecomputing. And behind each effort is a story of struggles and breakthroughs, successes and disappointments, hopes and promise. But most of all, each story is about what real people are doing to put the power of computer networking into the hands of teachers and students. These stories are included in Appendix B of this report.

There are no sure-fire formulas or recipes. Where it's working, a telecomputing infrastructure is built on the strengths and needs of the particular school and community. These stories should provide some clues about how the potential of telecomputing can be harnessed for schools.

2. Examples of teacher-developed projects in the Telemation Project. The California Department of Education funded a program that would utilize statewide Telementors to become trained and then to train Local Telementors at schools sites in the educational application of telecommunications. A project-based approach was used whereby the Telementors each developed "Curriculum Projects," classroom level plans designed to support the specific state and local education standards with unique applications of networking designed by teachers. These project plans would provide a description of the resources needed by each individual teacher to develop and implement their projects. The project evaluation showed that this approach was an effective strategy for ensuring that the training and staff development was targeted to building the capacity of the teacher to implement their projects. The project-based model also served as a vehicle for teachers to communicate and share their work with others. This project-based teaching approach is based on what was learned from the Monterey Model Technology Schools Classroom Intervention Plan (CIP) approach discussed in Section VII on Planning and Instructional Integration. For additional information on the Telemation Project, refer to the comprehensive evaluation of Telemation produced by Far West Laboratory (1995). What follows are some examples of the Telemation Projects.

- *Plastic Recycling and Waste Management.* This project involved students becoming aware of the difficulties of disposing of plastics. Students kept track of their own and their family's use of plastics. They contacted and shared information with environmentalists and waste disposal experts.
- *A Virtual Treasure Hunt in Spanish Speaking Countries.* Third year Spanish speaking students "adopted" students in a Spanish speaking elementary school classroom. They researched and telecommunicated information about a Spanish speaking country to the students in Spanish and presented the information to the elementary students in the form of a treasure hunt. Clues were developed from research done both off and on-line.
- *A Multi-age/Special Needs Collaborative Project.* Groups of students with highly divergent abilities worked together using a climate modeling computer package to predict what changes in the earth's climate would be affected if certain characteristics of the earth were changed.
- *Energy -- What's the Big Deal?* Students in combined math and science classes researched their own and the world's energy consumption. They learned about forms of energy and participated in projects in which they investigated different methods of

generating electricity. Special needs and LEP students were mainstreamed into all parts of this project.

These summaries describe the basic elements of the projects. Detailed information on these projects is in Appendix B. These represent only a few of the many projects initiated by Telemation. Presently, many of the teachers trained by the Telementors are developing their own projects. It is planned that all of these projects will be accessible on the Far West Laboratory Web site.

3. Input to the National on-line discussion on technology for staff development. Another question discussed on the National Technology Plan listserve was: *Are there any schools or communities that are using technology effectively for professional development?* Response to this question was very limited.

Unlike the other questions, it elicited a much lower level of participation. Those that did participate tended to list only one or two programs and even then provided little or no detail, especially as to why these programs were considered a success. The relative silence on this topic would seem to indicate that either there aren't that many effective examples or what is going on has not been well publicized in the education community.

Most of the examples featured distance learning as a way to effectively deliver professional development to a dispersed population. Examples included the Tennessee Valley Project which uses the Internet, the Porter County Education Interlocals provision of professional programming via satellite broadcasting with audio interaction, the California Telemation Projects telementor model, and Australia's use of a state-wide interactive satellite system. A number of programs based in the Laboratory on Technology and Learning in the College of Education at Appalachian State University use telecommunications to support professional development in North Carolina schools and the undergraduate teacher education program.

Subscribers provided several examples of school level programs in which the staff development includes teachers exploring ways to integrate technology into teaching and the curriculum. Some examples are the Apple Classrooms of Tomorrow (ACOT) and the Classrooms of Tomorrow Today (COTT) at Chapel Hill/Charborro district.

E. Model Schools as a Resource

Model Technology Schools and Classrooms. A number of states and districts have set up model technology schools, regular schools in which a special emphasis is placed on developing student skills with and through the use of technology. By creating technology-rich environments and enlisting the involvement of those teachers and administrators who are most enthusiastic, model technology sites can "pave the way" for other schools to follow and can yield lessons to guide later technology investments. These sites can also serve as living laboratories where others can visit and learn.

Monterey Model Technology Schools (MMTS) Project is one such example of a partnership between the Monterey Peninsula Unified School District and the California Department of Education. The MMTS project represents one of six projects funded by the California Department of Education "to develop and validate a wide range of technology-based instructional and administrative programs, practices and planning procedures to be disseminated to other schools throughout California." Although there are 24 schools in the Monterey Peninsula Unified School District, only four (two elementary, one middle, and one high school) are Model Technology Schools. The four schools were selected not on the basis of their

readiness to adopt technology, but on the criteria that schools had to be located in a community where the demographics of the student body mirrored the state as a whole, and the schools participating had to provide a continuum (i.e., the elementary schools fed into a participating middle school and then the participating high school).

The project was funded by the state, and all teachers in the participating schools, whose interest in and familiarity with technology varied greatly, were asked to commit themselves to the project. It was recognized that teachers embrace instructional technology use at different rates. By bringing together the technologically naive and fearful with the proficient and adventurous, it is possible to build a climate of mutual support and a culture of school technology use. It was anticipated that this process was more likely to be exportable to other schools than selecting a school where all teachers are "ready" to use technology.

Originally funded in 1987, the first five years focused on developing technology implementation projects and training, with dissemination activities targeted for year six onward. First-year training "Technology Awareness Days" centered around the subject areas of language arts, mathematics, and science to provide a general overview of what could be accomplished with educational technology. Gradually, what began as a technology training program evolved into instructional mentoring, changing the focus from broad curriculum areas and operating skills to an emphasis on targeted student outcomes and behaviors. At this point, MMTS developed the Classroom Intervention Plan (CIP), which became the centerpiece of the MMTS technology infusion model. Each teacher or teacher team developed a CIP outlining the curriculum emphasis (and its relationship to their school's planning goals and those of the California curriculum framework) and the desired and measurable end results; the necessary hardware, materials, and staff development; the evaluation plan; products and procedures for dissemination; and a budget (including substitute time). In addition to hosting scheduled visits by interested teachers and administrators, the Model Technology Schools provide training and dissemination activities to teachers from Monterey and other districts in California (Cradler, 1993). The following chart illustrates specific teacher-developed products that resulted from the development of the MMTS Classroom Intervention Plans.

Teacher Productions Showcasing Promising Practices

The following are examples of handbooks, software, and videos produced by Monterey Model Technology School teachers to illustrate technology activities they have used in their classrooms.

Minds In Motion
A series of learning activities for the elementary classroom using LogoWriterTM and Lego- logo kits in cooperative learning groups.

Integrating Technology Into the California Writing Project
This guide stands as a roadmap for teachers who wish to enhance the writing process through the use of instructional television, video, and computer technology.

Into the Eye of the Atom
This physical science unit has been developed to assist students in visualizing and conceptualizing the structure of atoms and molecules using laser, video, and computer technology.

Database of Dietary Choice
A guide to creative uses of databases and spreadsheets in the home economics curriculum.

The Whole CAKE: Computers Assisting Kids in Education
A team of elementary teachers developed this integrated, technology-based instructional model to help students improve their oral and written expression, increase exposure to quality literature, develop good handwriting skills, and improve the quality of television viewing.

Lit Vid Kits
This model was developed as a means of creating motivating language arts experiences in a school-to-home format for elementary students. Its focus is on English language acquisition and non-English-speaking parent education. It includes reading, listening, viewing, speaking, and writing activities related to thematic units in literature and science (available in English or Spanish).

An Integrated Approach to Geometry Using Manipulatives, Robotics, and Computers
This collection of classroom learning activities was developed to meet the needs of middle school students facing difficulties in mastering geometric concepts.

Echoes
This kit provides teachers with a model for developing units that intensify student interest in civics and economics and enhance cooperation in teamwork settings.

ARTT
This resource outlines planning, building and management of video libraries to enhance the instructional process in a secondary arts program.

SOURCE: California Model Technology Schools Project-Monterey, 1995.

F. Specific Applications of Telecommunications Supporting Reform

An essential ingredient and one of the primary rationales behind the education reform movement is the need to move traditional classroom curricula away from content-specific facts and information, and refocus attention on students becoming active, engaged learners. In place of rote recall of specific facts, curricula should emphasize depth of understanding, knowledge construction through analysis and synthesis of real-life problems, and the integration of content and sound pedagogy (Smith, O'Day, & Fuhrman, 1992). The recent research on the Apple Classroom of Tomorrow (ACOT) has documented ways that technology can enable teachers to more easily promote change that moves students from being traditional passive learners to more active and engaged learners.

In ACOT classrooms, new roles, new instructional practices, new ideas about assessment, and openess to system, and new ways to use technology underlie teachers' success. But the catalytic impact of technology in these environments cannot be underestimated. For example, technology:

- encourages fundamentally different forms of interactions among students and between students and teachers
- engages students systematically in higher-order cognitive tasks
- prompts teaches to question old assumptions about instruction and learning

Technology stands out in classrooms as a symbol to teachers, parents, and students that schooling can and will change, that classrooms may have some bearing on the 21st Century after all (Dwyer, 1994).

Because of the unique qualities inherent in educational technologies, learners can solve situational problems requiring the integration of higher order thinking skills. As Roger Larson, the Department of Defense Dependent Schools 1995 Presidential Award for Excellence in Science Teaching winner at Yokota High School recently said, "with the technology available in my classroom, students are asking better questions and solving more complex problems than ever before." In the past, students focused on the enormous effort of gathering and reporting data. Now that data is gathered with the help of classroom technologies (and appearing in real time), students' efforts are more focused on learning problem solving skills and understanding what the data means.

The various possibilities available through technology provide a multitude of different learning experiences. Some technology applications, like the SimCity Collaborative Project, allow students to work in teams to develop and attain successful approaches to problem solving exercises. Computer applications that help the user organize time, resources, and other planning elements can aid in project-based assignments. Online networks facilitate cultural exchanges and group investigation.

G. Summary

This section focuses on Classroom Applications and Examples of technology integration and provided some examples of the most effective uses of telecommunications and the resources accessed for teaching and learning. Examples and descriptions of models for the applications of some of the approaches discussed earlier were discussed. The model technology schools and various pilot projects such as the ACOT program are featured. Examples of classroom projects, such as those developed by the California State Telementors, provide additional information and resources that teachers may wish to follow-up on.

X. RECOMMENDATIONS FOR EDUCATIONAL APPLICATION OF TELECOMMUNICATIONS

What does the experience and research suggest for the effective use of technology and telecommunications to support more effective instruction and enhanced learning?

A. National Perspective

It is recommended that networking projects or programs demonstrate how networking can be used to achieve well-defined, compelling educational purposes. Such projects or programs should also promote change in the cultures of both teaching and learning. Content should be cross-curricular, multi-disciplinary, multi-dimensional, and multicultural. Collaborative learning should be encouraged within and among schools and communities, linking people of different ages, professions, ethnic backgrounds, and socioeconomic status (Breeden, 1994).

Educators need adequate introductory training for networking technology and *ongoing* training and user support. Networks are dynamic -- with changing software and resources -- and a time-pressed educator will demand reliability and quick fixes for any problems. Information about network resources and technologies should be disseminated widely and proactively (Breeden, 1994).

At planning and management levels, it is recommended that policies are developed to leverage existing expertise in network technology, as well as financial resources to promote the equitable and optimal use of networking. New partnerships with the greater community and private industry should be encouraged for funding, training, user support, and network-based curriculum development. Where possible, partnerships should also encourage the sharing of resources within and across communities of learners to achieve greater opportunities for equity. Communities with diverse economies and cultures can be networked together to share resources, learn from one another, and creatively work together to solve problems (Breeden, 1994).

Networking systems intended for widespread deployment should be open, scaleable, and replicable. Because an "open standard" is one that is publicly described and documented, any company or individual can build software or hardware based on that standard, and many players can compete in delivering the best and most cost-effective products. (On the other hand, the use of proprietary systems should be discouraged, since these often restrict future options and involve greater costs.) Ideally, schools in the same district, state, or region can replicate and scale to individual needs any pilot network that is based on open standards. The ultimate goal of a networking plan should be full Internet connectivity, and entry-level technology choices should be adaptable to that end. With open systems, educators can take advantage of a wealth of practical experience in technology deployment from the private sector to ease the learning curve (Breeden, 1994).

B. OTA Conclusions about what is Necessary to Implement Technology and Telecommunications in Education

SOME LESSONS ABOUT TECHNOLOGY IMPLEMENTATION

A number of schools, districts, and states have made the adoption of technology a priority. Important lessons from these sites include:

- **Educational rationale should guide technology decisions.** Developing a technology plan-- thinking through the goals for technology use at the local site and involving teachers in the planning process -- is key to successful implementation.
- **Those wishing to invest in technology should plan to invest substantially in human resources.** Training, maintenance, technical support and time to learn to use the technology have proven to be constant and continuing, yet key expenditures. Recently, several states (e.g., Texas and Florida) have recommended that at least 30 percent of technology funds be spent on training.
- **Teachers cannot use technology without systemic support.** The roles of principals, other administrators, and the community are critical in fostering sustained use of technologies. Other staff, such as media specialists, can provide technical and motivational support for teachers in their building if time is allocated for them to do so.
- **When it comes to learning to use technology "hand-on" training IS more than a gimmick or motivator.** It is a necessity. Teachers must have the chance to make the computer (or camera or whatever) work, and gain confidence in their own competence, before they try the same thing with their own class.
- **Access to equipment is essential.** It is extremely frustrating for teachers to learn to use technology in a workshop, then return to a classroom where the technology is not readily available. Many programs are increasing teacher access to technology by letting them take the equipment home (e.g., laptops, summer loaner programs, etc.) since most teachers put in many hours at home grading, planning, and preparing. Putting technology in the hands of teachers--allowing them to see and explore how technology can help them do their jobs--can be an effective way of motivating teachers to learn about technology.
- **Although there are a number of models for training teachers and implementing technology, there is no one best way of using technology or of training teachers to use technology**. Districts are most successful when they have multiple and complementary training and support strategies.
- **Follow-up support and coaching is as essential to effective staff development as is the initial learning experience.** Teachers don't "learn it all" at a training session--even if it extends over several weeks. When they return to the classroom the unexpected inevitably happens. At this point, teachers need to be able to reach out for technical assistance and support.
- **Many technology-rich sites continue to struggle with how to integrate technology into the curriculum.** Curriculum integration is central if technology is to become a truly effective educational resource, yet true integration is a difficult, time-consuming, and resource-intensive endeavor.
- **When conditions are right--resources, time, and support are high--exciting things happen in technology-rich environments.** Today we are faced with the broader issues of how to move these lessons to the second stage of dissemination. How can these lessons be translated when resources aren't as rich? W hen teachers aren't as enthusiastic or energetic? Issues for policy consideration include the need to consider the development of products based on research and experience of experimental sites, seeding of more "real world" projects, and better dissemination of lessons learned.

SOURCE: Office of Technology Assessment, 1995.

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C. Recommendations from the Council for Educational Development and Research.

A review of technology and reform conducted by the Council for Educational Development and Research (1995) concludes that for technology to be effectively applied in schools:

- Schools must connect technology to powerful learning designs and should not support a technology design that does not empower learning
- Schools must, from the outset, plan on connecting their technologies to the NII
- Schools must have the infrastructure in place before technology can be fully integrated into the curriculum
- Integration of technology into the curriculum is central if it is to become a truly effective educational resource

XI. Recommendations for State and National Policy

What does the information about telecommunications and technology use suggest for state and national policy?

A. National Perspective

State and Federal policy-makers are now in the process of formulating policies and legislation and programs related to providing access and integration of telecommunication and technology into education. This section provides suggested recommendations for policy-makers and other decision makers at the state and Federal levels.

The federal government can help ensure that teachers and learners can access and benefit from the information highway

There is little doubt the federal government should play a strong and active role in regarding education and the NII. As this report documents, there has been much attention to this issue, and in every case, findings generally suggest that the federal government should provide the policies to ensure educational access, along with necessary research and development, to offer models and guidance needed by states and localities for the successful design and application of technology in a variety of learning environments. To some extent the federal role in supporting technology in education has already been defined and recently put in statute with Goals 2000 and the Improving Americas Schools Act (IASA). This legislation established:

- National policy and planning leadership with the U.S. Office of Educational Technology
- National educational technology R & D partnerships between business and education through the national "Challenge Grants"
- Regional staff development and assistance for effective technology integration
- Grants for the local, planned application of technology to support teaching and learning
- Distance learning programs, instructional video development, and others

The design of these programs was guided by extensive study and research with a great deal of public input from the states. In fact, much of the language was derived from state policies that have proven themselves over time. The programs incorporated into this legislation were authorized and funded for FY 1995. However, proposed budget reductions may eliminate the opportunity for these programs to be fully developed and would eliminate other established programs already proven effective. If this happens, it is likely that many of these concepts will again be introduced in new legislation. In fact, some members of Congress are already considering legislation that would re-invent these programs.

Following are some suggested actions for the Congress:

- Rather than rescind the already minimal appropriation for educational technology, it is suggested that Congress increase appropriation to the amounts authorized.
- Congress should introduce and support telecommunications policies and legislation that provide incentives and special consideration to include education as one of the most critical components of the NII.

- Provide policy guidelines, research, and leadership across federal agencies and programs that will promote and leverage state and local planning, implementation, and funding for the integration of technology to support teaching and learning.
- Consider and promote technology in education as a critical factor in preparing standards to contribute to the technology future and related economic survival of the country.

There is more than enough evidence to justify a strong federal role in ensuring that all citizens have access to information and education on the National and Global Information Highway. It is clear that the states alone cannot make this happen.

B. National Actions to Promote Education Access to the NII

Goals 2000: the Educate America Act promotes the integration of technology into state planning and implementation of high education standards. It established a U.S. Office of Educational Technology that will develop a national long range plan for technology in education and provides funding for the development of technology plans in each state. Goals 2000 establishes technology as a key factor in ensuring that students meet high academic standards, as well as increasing opportunities to learn.

The Improving America's School Act (ESEA reathorization) offers another set of reforms with technology playing an important role:

- Regional staff development and technical assistance augmented by distance learning resources
- Continuation of the Star Schools legislation with an increased emphasis on the use of these resources to provide staff development to areas currently undeserved
- Research and development related to new and emerging technologies to support teaching and learning
- Support for digital libraries....to bring libraries into the information age by linking library resources to schools and communities through the NII
- Incentives for industry to develop and evaluate for dissemination new content-based applications of technology to support the national education standards
- Development of new policies and legislation that support universal access by education to the NII and its abundance of information resources
- Coordination and leveraging of the resources of federal agencies, such as the Department of Education, Department of Defense, and National Science Foundation, to support the NII for education
- Fully fund Title III of the Improving America's Schools Act, to include: Regional Technology Assistance Consortia, Eisenhower Staff Development Grants, Educational Technology Research and Development Grants, and the Star Schools Distance Learning Projects

C. Possible State Actions to Help Implement an Education Agenda for the NII

The federal government views the states as partners in its efforts to evolve the NII for access and application in education. Initiatives such as Goals 2000, IASA, and the School to Work Act but are intended as national initiatives to provide leadership by the federal government and provide limited fiscal support. States and local communities will make or break these initiatives and can be involved in the following activities:

- Participate in the development of the state Goals 2000 educational improvement plan and ensure that the authorized technology plan is actually developed an implemented. Work with the state superintendent and the governor to accomplish this activity.
- Incorporate effective and meaningful applications of technology in the forthcoming School-to-Work state grants. Most employers expect the emerging workforce to be ready to meet the technological challenges of the 21st century in the world of work.
- Work with the California Public Utilities Commission to establish special rates for schools, surcharges to raise funds for educational telecommunications and distance learning, and the development of state PUC policies that encourage education as a priority for telecommunications access. Presently 18 states are known to be working with their PUCs to accommodate education in their plans.
- Develop state legislation that reflects and augments the various national initiatives ,with special consideration for educational applications of distance learning and information technologies.
- Set a state education goal that promotes the applications of technology to support state education performance and workforce skill standards.
- Establish meaningful and complementary partnerships between education and business.
- Utilize the resources of the Regional Educational Laboratories to assist in developing state and local plans for educational technology.
- Share information with other states on ways to fund and implement information technologies.
- Closely monitor and make efforts to apply for various federal grants designed to promote local technology initiatives.
- Work with providers of telecommunications and video resources to establish initiatives in support of distance learning and telecommunications in teaching and learning.

D. Considerations for an Expanded R&D Agenda for Educational Technology

Most studies are formative and summative evaluations of various existing technology applications in education. Little funding has been expended for in-depth R&D for education -- especially grades K-12. A recent report from the White House Office of Science and Technology Policy (OSTP) reported that less that one percent of the amount expended for R&D in technology-related defense training is expended for similar purposes in education. This statistic is also commonly reported for business and industry in comparison to education. So far the emphasis has been more on qualitative research and evaluation and less on development and validation. Development has occurred by industry but has not been connected to research. Before technology can have a long term impact on education it is necessary to have a strong R&D agenda that promotes development combined with the needed research to inform the education community and education stakeholders about effective practices and products. The research should help to determine the extent to which these new practices and products related to

technology promote needed education reform. An expanded R&D agenda is important and should focus on the following:

- User friendly and educationally relevant information databases for the National Information Infrastructure
- Applications of technology to promote desired state and national education reforms
- The use of telecommunications and distance learning for teacher staff development
- Identification and dissemination of model technology programs, practices, and projects
- Identification of occupational skills standards related to technology applications
- Using technology to disseminate information resources that provide systemic reform
- Integration of technology into National Education Reform initiatives (Goals 2000, ESEA Reauthorization, school to work, etc.)
- Development of effective educational software, multimedia, and video for school and home use
- Study of the positive and negative consequences of technology on education and society

R&D that addresses these and other priorities is critical if educators are to be knowledgeable about and effective use of technology to improve teaching and learning. It is widely believed that schools and teachers are not technologically equipped to prepare students for the 21 century. A strong R&D agenda with sustained financial support can help meet this national need (Cradler, 1994).

E. Input to the National On-line Conference on the Federal Role in Promoting Technology for the Professional Development of Teachers

In the online discussions of for the National Technology Plan, respondents answered the question: *What should the role of the Federal government in promoting the use of technology for the professional development of teachers?* This question elicited both suggested lists of specific activities and some varying concerns about what role the federal government plays in a locally-driven education system. For the purposes of this summary, the more general discussion on the appropriate federal role is noted but not detailed. Subscribers suggested that the federal government could promote the use of technology for professional development in the following ways:

- *Promote awareness and commitment to the use of technology.* As one participant put it, "We can do anything if it becomes a national priority." Quite a few subscribers argued that the federal government could play a significant public relations role in promoting understanding and commitment to infusing technology into the education system.

- *Facilitate the creation of the basic communications infrastructure.* Many noted that the federal government has already been pivotal in funding the beginnings of the Internet. In this role the federal government could assist in establishing/coordinating the specifications of the system, guide and support private sector development of hardware and software through tax or other incentives, and ensure access to public sector sources of information. Some saw the federal government as a good candidate to fund aspects of the system, such as the basic tools for using the Internet.

- *Support basic research and provide/facilitate expertise.* Participants suggested the Department of Education should fund research into the best ways to use technology

throughout the education system, especially strategies that most effectively address the learning styles of students at different grade levels. Subscribers thought of other assistance roles for the federal government, including developing a national network of registered technology expert volunteers, a national newsletter highlighting exemplary programs, creation of a centralized posting place for exemplary plans and lessons, promoting more direct connections between the regional labs and schools or districts, creating a Technology Corps (college/graduate students with technology training serve a 2 year tour at a school), and making available to the schools the digitally-base training education materials created for the professional development of federal employees and military personnel.

- *Convene national and regional forums.* Many see the federal government as well positioned to promote more communication and exchange of information among states, districts, schools, teachers and experts by convening forums and symposiums. A number of participants indicated they would like to have more opportunities patterned after this on-line discussion of the national technology plan.

- *Provide direct assistance to teachers.* A number of participants suggested ways that the federal government could more directly encourage teachers to seek training and experience with technology. These included suggestions for a national teaching certificate that would require technology proficiencies and tax incentives or low interest loans for teachers to buy their own computers/equipment or enroll in relevant coursework. Another suggestion was a tax incentive to private industry to produce and donate software tailored to district needs and use teachers to co-develop the software.

Finally, some participants wanted the federal government to play an active role in providing equity of access to technology. Some saw this as a funding problem and looked either for direct federal contributions or federal guidelines on resource distribution to address this concern.

XII. RESOURCES FOR INSTRUCTION AND POLICY DEVELOPMENT

What are the most useful resources to assist educators and policy-makers in planning and utilizing technology and telecommunications to support teaching and learning?

Effective educational technology and telecommunications applications should be developed, identified, and disseminated. An identification and dissemination process should be established and coordinated among the Regional Education Laboratories, the Department of Energy Laboratories, the National Science Foundation, and Department of Education programs. Existing dissemination systems such as the Eisenhower National Clearinghouse, ERIC, and the National Diffusion Network should be incorporated into this process. The seventh NCC-TET Requirement established as a top priority to "*Identify and disseminate effective education and training applications of the NII*" (NCC-TET, 1994).

This section provides information about documents and programs currently available that may be of help in planning, implementing, evaluating, and funding educational technology and networking at the state, regional, and local levels.

1. Planning

These suggested resources will help states and local education agencies through all steps of the planning process from issues to consider to planned action steps.

TECHNOLOGY PLANNING FOR THE *GOALS 2000* STATE IMPROVEMENT PLAN
Cradler, J and Cordon-Cradler, R.
U.S. Department of Education 1995.
(202) 401-1444

This book provides step by step planning guidelines and resources to help states develop technology plans that integrate with *Goals 2000* and other educational reforms.

THE TECHNOLOGY ADVISORY COUNCIL: A VEHICLE FOR IMPROVING OUR SCHOOLS
Austin, Tackett, et. al. (1993)
International Society for Technology in Education
1787 Agate Street
Eugene, OR 97403-1923
(503) 346-4414

This book provides direction for developing a Technology Advisory Council and future activities of the council and includes:

- building a Technology Advisory Council
- the strategic planning process
- current and future technology
- goals for technology in education
- staff development
- sources of funding
- recommended reading
- video resources

TEACHING, LEARNING & TECHNOLOGY
Apple Computer, Inc.
20525 Mariani Avenue
Cupertino, CA 95014
(408) 996-1010

This planning guide consists of a comprehensive interactive multimedia package to guide users through a:

- step-by-step planning process
- process to find other successful models
- successful presentation of the plan
- support to match your setting and technology

2. Goals 2000, Educational Reform, and Technology

It is important to review materials related to *Goals 2000* and education reform to gain a more in-depth understanding of how technology can be used at the state and local level to improve teaching and learning.

TEACHERS & TECHNOLOGY: MAKING THE CONNECTION
Office of Technology Assessment
Congress of the United States
U.S. Government Printing Office, 1995.
(202) 512-1800
http://otabbs.ota.gov/T128/

This document provides comprehensive recommendations and background information to assist planners in developing staff development and teacher preparation programs at the state, regional, and local level. This is a critical document for anyone attempting to design and implement a technology plan that supports teaching and learning.

USING TECHNOLOGY TO SUPPORT EDUCATION REFORM
U.S. Department of Education
Means, Barbara; Blando, John; et. al. (1992)
U.S. Government Printing Office
Superintendent of Documents
Mail Stop: SSOP
Washington, DC 20402-9328
(202) 783-3238 FAX (202) 512-2250

This study shows how technology can support education reform and includes the following:
- technology applications to teaching and learning
- support for student activities
- support for teacher functions
- effects on student achievement
- implementation issues

TECHNOLOGY AND EDUCATION REFORM: THE REALITY BEHIND THE PROMISE
Means, Barbara, ed. (1994)
SRI International
333 Ravenswood Avenue
Menlo Park, CA 94025-3493

This book provides concrete illustrations of:
- how technology can support school reform
- specific kinds to promising technologies
- how technology can help both students and teachers accomplish tasks
- technology to increase student learning and teacher training

LINKING FOR LEARNING: A NEW COURSE FOR EDUCATION
Fulton, Kathleen; et. al. (1989)
U.S. Congress Office of Technology Assessment
U.S. Government Printing Office
Superintendent of Documents
Mail Stop: SSOP
Washington, DC 20402-9328
(202) 783-3238 FAX (202) 512-2250

This study examines the use of technology and distance learning to improve quality education for students and training for teachers and contains an analysis of:
- distance education in today's classrooms choices for distance learning systems
- new opportunities for teachers
- States as catalysts for change
- Federal activities in distance education
- State by state profile
- sample costs of transmission systems

3. Curriculum Resources Related to Technology

These resources may help in the planning of identifying technologies to support curriculum.

DISTANCE LEARNING RESOURCE NETWORK TECHNOLOGY RESOURCE GUIDE
Lane, Carla (1993)
Distance Learning Resources Network
Far West Laboratory
730 Harrison Street
San Francisco, CA 94107-1242
(800) 622-4160
http://www.fwl.org

This guide provides information on various types of technology resources to help plan for what will be needed in schools.

- comparison of teleconferencing technologies
- business television and adaptation for education
- multimedia technologies and applications
- learning styles, model programs, and needs analysis

CURRICULUM GUIDELINES FOR ACCREDITATION OF EDUCATIONAL COMPUTING AND TECHNOLOGY PROGRAMS
Thomas, Lajeane, et. al (1993)
International Society for Technology in Education
1787 Agate Street
Eugene OR 97403-1923
(503) 346-4414

This document will assist planning committees to provide guidance to teacher preparation institutions to develop programs in educational computing and technology and includes:

- levels of preparation in computing and technology
- unit accreditation recommendations
- folio review process and special instructions

4. Policy Reports

These documents can serve as models or prompts to help in the design of statewide visions, policies, goals, and platforms for educational technology.

THE NII AGENDA FOR ACTION
Clinton, William
Executive Office of the President
1600 Pennsylvania Avenue, NW
Washington, DC 20500
(202) 456-7035
http://www.whitehouse.gov/White_House/Publications/html

PUTTING THE INFORMATION INFRASTRUCTURE TO WORK: Report of the Information Infrastructure Task Force, Committee on Applications and Technology
National Institute for Standards and Technology
Building 225, B164
Gaithersburg, MD 20899

THE NATIONAL INFORMATION INFRASTRUCTURE: REQUIREMENTS FOR EDUCATION AND TRAINING.
Cradler, John and Yrchik, John (1994)
National Coordinating Committee on Technology in Education and Training
P.O. Box 4437
Alexandria, VA 22303
(703) 351-5243
iste@seas.gwu.edu
http://iste-gopher.uoregon.edu/

VISION: TEST RECOMMENDATIONS FOR AMERICAN EDUCATIONAL DECISION MAKERS
Braun, Ludwig (1990)
International Society for Technology in Learning
1787 Agate Street
Eugene, OR 97403-1923
(503) 346-5191
iste@oregon.uoregon.edu

EDUCATIONAL TECHNOLOGY
Brown, E. Scott, et. al. (1993)
National Education Association
1201 16th Street, NW
Washington, DC 20036
(202) 822-7715

CEDaR POLICY PLATFORM ON EDUCATIONAL TECHNOLOGY
Council for Educational Development and Research Technology Policy Group (1992)
CEDaR
2000 L Street, NW, Suite 601 Washington DC 20036
(202) 223-1593

IMPROVING STUDENT PERFORMANCE THROUGH LEARNING TECHNOLOGIES Council of Chief State School Officers (1991)
CCSSO
One Massachusetts Ave, NW, Suite 701
Washington, DC 20001
(202) 336-7003

PLUGGING IN: CHOOSING AND USING EDUCATIONAL TECHNOLOGY,
Council for Educational Development and Research, 1995
(202) 223-1593
http://www.ncrel.org/sdrs/edtalk.toc.html

5. Distance Learning and Instructional Television

Distance learning provides an important educational resource–especially in rural and geographically isolated regions. Some resources to consider are provided.

PUBLIC BROADCASTING SERVICE
1320 Braddock Place
Alexandria, VA 22314
(703) 739-5071

The Public Broadcasting Service (PBS) funds and distributes instructional programs for adult learners and elementary and secondary students and offers:
- telecourses for adult learning
- elementary and secondary instructional programs
- elementary and secondary professional development

CABLE IN THE CLASSROOM
86 Elm Street
Peterborough, NH 03458
(800) 743-5355
Cable in the Classroom is a non-profit service of the cable industry that provides:
- free installation and basic service to all public schools
- free non-commercial programming
- schools receive support materials

TEACHER TV
Barbara Stein
National Education Association
1201 16th Street, NW
Washington, DC 20036
(202) 822-7715
Teacher TV is a co-production of the National Education Association and The Learning Channel. Programs include:
- case studies of issues facing teachers in schools
- sharing the best educational strategies
- professional development for teachers

NATIONAL DISTANCE LEARNING CENTER (NDLC)
University of Kentucky Owensboro Community College
400 New Hartford Road
Owensboro, KY 42303
(502) 686-4556
(502) 686-4555 modem dial-up

The NDLC operates an electronic clearinghouse for distance learning information and resources and provides information regarding:
- curriculum guides
- development aids
- teacher in service training programs and materials
- research

STAR SCHOOLS PROJECTS
Cheryl Garnette
U.S. Department of Education
Office of Educational Research and Improvement
555 New Jersey Avenue, NW
Washington, DC 20208
(202) 219-2116
http://www.ed.gov

The Star Schools Program is a discretionary grant program that supports telecommunications partnerships to provide telecommunications equipment and programming to schools. Live interactive instructional programs, staff development, and community awareness activities are produced via satellite, compressed video, fiber optics, videodisc, and microcomputer-based networks. The Star Schools dissemination projects have established clearinghouses of information about distance learning.

6. Computer Software, videotapes, and multimedia

Software, videotapes, and multimedia can be very useful to the planner in promoting awareness and visualizing models that may be adaptable in the state.

LINKING DREAMS TO REALITY
Educational Technology Office
California Department of Education
P.O. Box 944272
Sacramento, CA 95814
(916) 657-5414.

This video shows components of the California educational technology program to provide:
- demonstration of a state plan
- possible model for public relations use

EXPERIENCE THE POWER: NETWORK TECHNOLOGY FOR EDUCATION
National Center for Education Statistics
Elementary/Secondary Education Statistics Division
555 New Jersey Avenue, N.W.
Washington, DC 20208-5651
FAX (202) 219-1728

This National Center for Education Statistics-produced videotape includes:
- awareness of the role of telecommunications in schools
- introduction by Secretary Riley and Linda Roberts
- shows the high priority the federal government is placing on educational technology

GLOBAL QUEST: THE INTERNET IN THE CLASSROOM
K-12 NREN Video
Teacher Resource Center
NASA Ames Research Center
Mail Stop T-025
Moffett Field, CA 94035
FAX (415) 604-3445
GET.VIDEO@QUEST.ARC.NASA.GOV
A video to motivate schools to consider using the Internet by the NASA National Research and Education Network (NREN) K-12 Initiative.

FAR VIEW and LEARNING FOR ALL
Pacific Mountain Network
1550 Park Avenue
Denver, CO 80218
(303) 837-8000

Video tapes of distance learning activities and programs to include:
- Star Schools Projects information and resources
- other distance learning resources such as Cable in the Classroom and Galaxy Classroom
- seven-part series on school restructuring
- real-life situations in schools and communities

7. Support Resource Agencies

The following agencies provide a wealth of support services and resources that will be of use in implementing the plan, and for follow-up activities and evaluations.

REGIONAL EDUCATIONAL LABORATORIES AND RESEARCH CENTERS
The Regional Laboratories and Centers each offer resource to support planning and technology implementation. These range from research on telecommunication use, planning assistance, information databases, distance learning, professional development and in some cases, technical assistance to states and districts. The level and type of service varies among agencies. Contact the individual in your region to determine specific support offered.

Far West Laboratory
Serves AZ, CA, NV, UT
John Cradler
(415) 565-3000

Northwest Regional Educational Laboratory
Serves AK, ID, MT, OR, WA
Jerry Kirkpatrick
(800) 547-6339

Pacific Regional Educational Laboratory
Serves American Samoa, Commonwealth of the Northern Mariana Islands, Federated States of Micronesia, Guam, Hawaii, Marshall Islands, Palau
Kay Noguchi
(808) 532-1900

REGIONAL TECHNOLOGY ASSISTANCE CONSORTIA.
Contact U.S. Department of Education for information about the regional RTC serving specific states at 202-219-8070.

Recently six regional interstate consortia of state agencies, professional organizations, and business were funded to provide support services to states and regional agencies and school districts to support the planning, implementation, and funding of technology in education. State DOEs and other agencies in may wish to use the RTC services to assist in the implementation of the HETP.

NATIONAL CENTER FOR TECHNOLOGY PLANNING
Larry Anderson, Director
Department of Technology & Education
Mississippi State University 39762
(601) 325-2281
Lsa1@ra.msstate.edu.
http://www2.msstate.edu/~Lsa1/nctp

NCTP is a clearinghouse for the exchange of information and assistance related to technology planning and contains:
- on-line school district technology plans
- electronic monographs on selected topics
- consulting
- workshops
- technology planning aids (such as checklists, brochures, and sample planning forms)

CALIFORNIA COMPUTER SOFTWARE AND INSTRUCTIONAL VIDEO CLEARINGHOUSES
Stanislaus County Office of Education
(Video)
801 County Center Three Court
Modesto, CA 95355-4490
(209) 525-4993
CSU Long Beach (Software)
1250 Bellflower Boulevard
Long Beach, CA 90840-1402
(310) 985-1764

These clearinghouses provide on-line preview guides for educators to gain access to an inventory of instructional technologies in support of State curriculum standards.

NEA SCHOOL RENEWAL NETWORK
Shari Castle
NEA National Center for Innovation
1201 16th Street NW
Washington, DC 20036
(202) 822-7783

Dedicated to school reform, this electronic network is intended to:
- create a research base by a community
- actively engage practitioners

NATIONAL DIFFUSION NETWORK
To identify your State Facilitator contact the NDN at:
Office of Educational Research and Improvement
U.S. Department of Education
555 New Jersey Avenue, NW
Washington, DC 20208-5645
(202) 219-2134.

A nationwide system to help schools and education-related agencies improve through the adoption of locally developed, rigorously evaluated, exemplary educational programs. The NDN disseminates information on:
- NDN exemplary Developer/Demonstrator programs
- in-service training
- follow-up assistance to school personnel
- matching services and resources to needs

CENTER FOR CHILDREN AND TECHNOLOGY
Margaret Honey
Center for Children and Technology
610 West 112th Street
New York NY 10025
(212) 875-4560
Internet: mhoney@edu.org

The Center provides the following services and resources:
- research on effects of technology on students
- design and development of prototypical software that supports engaged, active learning
- It also serves as the New York Office of the Educational Development Center
- The Center for Children and Technology offers a free quarterly newsletter and low-cost publication

CENTER FOR EDUCATIONAL LEADERSHIP AND TECHNOLOGY
John Phillipo
Center for Educational Leadership and Technology
165 Forest Street

Marlborough, MA 01752
(508) 624-4877 FAX (508) 624-6565

An educational agency to integrate educational reforms and research with effective uses of technology and provides assistance for technology planning to include:
- planning school and campus facilities
- designing communication and management networks
- demonstrating technologies
- determining instructional technology planning
- applying research findings to planning
- planning for comprehensive staff development

8. Professional Organizations

National and regional professional organizations can be helpful in planning for technology in education and may provide a wealth of resources, models, and guidance. Many of these organizations hold annual conferences for the purpose of holding seminars, training, and workshops, for networking with those experienced in the field of educational technology.

ALLIANCE FOR DISTANCE EDUCATION IN CALIFORNIA (ADEC)
Elizabeth Rhodes, President
c/o Sacramento Eductaional Cable Consortium
2595 Capitol Oaks Drive, Suite 178A
Sacramento, CA 95833
(916) 920-1006

ADEC is an advocacy organization to promote distance education in California and exchang ideas between professionals in related fields. Membership includes the annual Distance Learning Summit, receipt of the ADEC *In the Loop* newsletter, and continuing communication through the ADEC listserv.

COMPUTER-USING EDUCATORS, Inc.
1210 Marina Village Parkway, Suite 100
Alameda, CA 94501
(510) 814-6630
cueinc@aol.com

CUE is a membership organation and network of educators and educational technology stakeholders. CUE maintains an active advocacy program, presents two conferences annually, co-sponsors various folm and video festivals, and develops and distributes SoftSwap (teacher created educational software).

THE CONSORTIUM FOR SCHOOL NETWORKING (CoSN)
CoSN membership
1250 24th Street, NW, Suite 300
Washington, DC 20035
(202) 466-0533
info@cosn.org

CoSN is a membership organization of institutions formed to further the development and use of computer network technology in K-12 education and provides:
- sharing of resources and experience of all members
- demonstrations of state and local networks
- software and hardware recommendations
- discounts on products and services
- development of policies for network use
- participation in collaborative projects
- mini-grants and contests for teachers

NATIONAL EDUCATION ASSOCIATION (NEA)
NEA
1201 16th Street, NW
Washington, DC 20036
(800) 827-6364

The nation's largest professional employee organization that provides:
- small grants through its National Foundation for the Improvement of Education
- telecommunications services through NEA On-line
- published resource materials
- research through its Center for Innovation

COUNCIL OF CHIEF STATE SCHOOL OFFICERS (CCSSO)
Frank Withrow
Council of Chief State School Officers
1 Massachusetts Avenue, N.W., Suite 700
Washington, DC 20001
(202) 408-5505

CCSSO represents each State's chief education administrator and provides direct assistance for:

- systemic planning issues
- policy development
- coordination of activities at State and Federal level
- research on issues affecting education

INTERNATIONAL SOCIETY FOR TECHNOLOGY IN EDUCATION (ISTE)
Lynne Schrum, ISTE
1787 Agate Street
Eugene, OR 97403-1923
(503) 346-4414
The largest international nonprofit professional organization serving computer-using educators and provides:

- on-line computer network for members
- resources on planning and technology implementation
- research and information on publications
- state affiliate organizations for technology users
- assistance with national policy for technology development

9. Business partnerships

The *Goals 2000* legislation strongly encourages the inclusion of business and industry in the planning and implementation of educational technology programs for the State. Following are resources and examples of business involvement in education.

SYNTHESIS OF EXISTING KNOWLEDGE AND PRACTICE IN THE FIELD OF EDUCATIONAL PARTNERSHIPS
Grobe, Terry (1993)
U.S. Department of Education
Programs for the Improvement of Practice
555 New Jersey Avenue, NW
Washington, DC 20208
(202) 219-2164

This paper discusses the major elements of successful business/educational partnerships including:

- community needs
- strategic planning
- shared decision making
- resources
- technical assistance
- evaluating partnerships

BRING BUSINESS AND COMMUNITY RESOURCES INTO YOUR CLASSROOM
Otterbourg, Susan (1992)
National Education Association
1201 16th Street NW
Washington, DC 20036
(202) 822-7783

This handbook offers educators detailed step-by-step guidance for establishing school-business partnerships and includes sample forms, letters, agreements, and case studies.

10. Internet Resources

Much information and many resources for plan development and implementation can be obtained through the vast array of telecommunication databases. Resources range from planning, legislative authority, and funding to software, instructional ideas, and model programs that can be incorporated into school improvement plans or modified to address the needs of the area.

Information and resources can be gathered from various commercial networks or from the innumerable servers on the Internet. There are a growing number of state, regional, and local networks for the exchange of ideas, lesson plans, planning, and curriculum development. Contact your state education agency for FARNET, which will refer callers to state and local networks around the country: FARNET, 100 Fifth Avenue, Waltham, MA 02154; (617) 890-5120. Following are examples of public and commercial educational information and resources networks.

INTERNET

Internet is a global "network of networks" that provides users with access to a vast array of information and a collection of education resources. Educators seeking to get involved with networking should aim for access to the Internet; those already connected to

commercial network services have gateways to the Internet as well.

U.S. DEPARTMENT OF EDUCATION INSTITUTIONAL COMMUNICATIONS NETWORK (INet)
INet Project Manager
U.S. Department of Education
Office of Educational Research and Improvement
555 New Jersey Avenue, NW, Room 214
Washington, DC 20208-5725
(202) 219-1547
modem (800) 241-4638
gopher.ed.gov

This directory provides general information about the U.S. Department of Education:
- the *Goals 2000* Initiative
- information and resources from ERIC
- educational research and statistics
- U.S. Department of Education publications
- educational software databases
- directories of effective programs
- descriptions of Dept. of Education programs
- education-related information centers
- Technology Challenge Grants
- Regional Technology Consortia

EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)
ERIC Clearinghouse on Information and Technology
Center for Science and Technology
Syracuse University
Syracuse, NY 13244-4100
(315) 443-3640
askeric@ericir.syr.edu

ERIC is a federally funded national information system that provides access to an extensive body of education-related information and resources and include the following topics:
- developing school technology plans
- science, math, and environmental education
- assessment and evaluation
- teaching and teacher education
- research on the benefits of technology

ASKERIC
ASKERIC@ERICIR.SYR.EDU
An online question-answering service for ERIC for educators, parents, and community members to obtain information regarding:
- ERIC resource collections
- lesson plans
- short summaries of research
- literature searches on popular topics

SPACELINK
Dr. Malcom Phelps
Education Division, Technology & Evaluation Branch
(202) 358-1540; mphelps@hr.hq.nasa.gov
(205) 895-0028 dial up access or Internet

A collection of NASA information and supplemental educational materials and a teacher resource center. Resources that may be found include:
- space explorations
- NASA educational services
- instructional materials
- space program research

AMERICA ONLINE
America Online
8619 Westwood Center Drive, Suite 200
Vienna, VA 22182
(800) 827-6364.

America Online offers a wide variety of services, including electronic mail, conferencing, software, computing support, interactive magazines and newspapers and online classes, as well as numerous national education agencies, resource databases, and conferencing forums. For example, the Learning and Reference Department offers:
- the Parents Information Network, designed to increase parental involvement in education, includes a forum for information on school reform initiatives, a Parent-Teacher Conferencing Forum for the exchange of ideas and issues of concern, and a database for information on study skills with lesson plans to be used at home
- the National Staff Development Council database includes information on staff development standards and practices and offers catalogs of information and resources

NEA ONLINE
NEA Starter Kit
(800) 827-6364, ext. 7468

NEA Online is an interactive communications medium geared toward educators that enables the user to easily communicate with other members of the National Education Association and includes:

- new ideas for public schools
- access to latest education research
- share lesson plans with colleagues
- current grants and scholarships

PBS LEARNING LINK
PBS ONLINE
1320 Braddock Place
Alexandria, VA 22314
(703) 739-8464

Learning Link is a computer-based, interactive communication system for K-12 educators, students, adult learners, and public television viewers and provides:
- a database of public television programs
- the "Curriculum Connection" for instructional videos
- CNN Newsroom Classroom Guides
- lesson plans and class projects on timely events

NATIONAL GEOGRAPHIC KIDS NETWORK
National Geographic Society
Educational Services
Washington, DC 20036
(800) 368-2728

Kids Network is an international telecommunications-based science and geography curriculum for fourth-through sixth-graders to engage students in projects such as:
- collaborative research assignments
- investigations on geographical/ environmental studies
- work with scientists on research projects

SPECIALNET
GTE Education Services
GTE Place
West Airfield Drive
PO Box 619810
Dallas/Fort Worth Airport
Texas 75261-9810
(800) 927-3000.

Sponsored by the National Association of state Directors of Special Education, it includes a variety of bulletin boards in the fields of learning disabilities, parent involvement programs, and special education issues and offers to educators and administrators special education information to keep in mind during planning such as:
- early childhood education programs
- vocational and school-to-work
- parent advocacy and involvement
- legal issues and court cases

11. Telecommunications and the National Information Infrastructure

The following resources will assist the state planning council to provide information and examples of using telecommunications in education.

CALIFORNIA NETWORK TECHNOLOGY PLANNING GUIDE
Teach, Carole, et. al. (1994)
California Department of Education
Educational Technology Unit
P.O. Box 944272
Sacramento, CA 94244-2720
(916) 657-5414
This guide serves as a planning framework to and may assist in:
- developing an implementation model
- determining appropriate technologies
- construction of access to the electronic highway
- local implementation
- review of networking standards
- technical model for K-12 networking
- staff development and training

TOOLS FOR CHANGE: RESTRUCTURING TECHNOLOGY IN OUR SCHOOLS
Scrogan, Len (1993)
Institute for Effective Educational Practice
637-B S. Broadway, Suite 302
Boulder, CO 80303

This guide was designed for the educational decision maker to help:
- measure the effectiveness of current technology programs
- determine school/district priorities
- match instructional needs with current and future investments in technology

EDUCATOR'S INTERNET COMPANION
Wentworth Worldwide Media , Inc.
1866 Colonial Village Lane
Lancaster, PA 17605
(717) 393-1000
A complete guide to educational resources on the internet that includes 30 lesson plans that integrate the Internet into the curriculum and put students and teachers online.

EDUCATION ON THE INTERNET: A HANDS-ON BOOK OF IDEAS, RESOURCES, PROJECTS, AND ADVICE.
SAMS Publishing
201 West 103rd Street
Indianapolis, Indiana 46290
Includes such topics as:
- Internet resources by curricular area
- The internet and the Classroom
- How to find more K-12 Information
- Teaching and learning with Computer-mediated communication
- Quick guide to the Internet and its tools

WAY OF THE FERRET: FINDING EDUCATIONAL RESOURCES ON THE INTERNET
ISTE Publications 1787 Agate Street
Eugene, Oregon 97403
(503) 346-14414
Topics include:
- Educational Applications
- Interpersonal Resources
- Information location tools
- Receiving and unpacking electronic information.

EDUCATIONAL TELECOMMUNICATIONS: THE STATE BY STATE ANALYSIS
Hezel Associates (1994)
Hezel Associates
1201 E. Fayette Street
Syracuse, NY 13210
(315) 422-3512

This yearly report documents statewide educational telecommunications activities and focuses on developments in telecommunications planning. The analysis assists in statewide planning by providing information on:
- trends in statewide telecommunications planning
- education reform and economic development
- telecommunications regulations
- statewide adoption of newer technologies
- educational telecommunications providers
- analysis of state by state activities

INFORMATION INFRASTRUCTURE SOURCE BOOK
Kahin, Brian, ed. (1993)
Yvonne Hickey
Office of Information Technology
Harvard University
1730 Cambridge Street, Room 202
Cambridge, MA 02138
(617) 496-4077 FAX (617) 495-0715
yvonne@harvarda.harvard.edu
This source book documents policy development for information infrastructure to serve as a compact reference for planners and policy-makers and includes:
- historical and policy documents
- vision statements and position papers
- program and project descriptions
- pending federal legislation

12. Research and Evaluation Studies, Reports, and Guidebooks

state planning panels may wish to review research materials and the documented effects of technology on student learning. These guidebooks and many evaluation reports previously conducted in other states will be of help in the planning process and in subsequent evaluation of the plan and programs.

ANALYSIS AND TRENDS OF SCHOOL USE OF NEW INFORMATION TECHNOLOGIES
Becker, Henry (1994)
U.S. Government Printing Office
Superintendent of Documents

Mail Stop: SSOP
Washington, DC 20402-9328;
(202) 783-3238 FAX (202) 512-2250

This resource will help to decide how and what technologies to consider for your plan and information on how to ensure technology to support curriculum.

ADULT LITERACY AND NEW TECHNOLOGIES: TOOLS FOR A LIFETIME.
Roberts, Linda, et. al. (1993)
Superintendent of Documents
P.O. Box 371954
Pittsburgh, PA 15250-7954
(202) 783-3238 (202) 512-2250

This study assesses the current and potential impact of technologies for adult literacy and highlights:
- examples of state and local efforts
- impact of federal efforts
- improving the system
- experimenting with new alternatives

TELEMENTORING: AN EXAMINATION OF THE POTENTIAL FOR AN EDUCATIONAL NETWORK
Wighton, David (1993)
ERIC Clearinghouse on Information and Technology
Center for Science and Technology
Syracuse University
Syracuse, NY 13244-4100
(315) 443-3640
askeric@ericir.syr.edu

This report explores the potential use of "telementoring", the use of mentor teachers for educational telecommunications networks and includes findings on the following:
- the teacher mentoring role - "telementoring"
- the idea of electronic mentoring
- review of mentoring literature
- outline of lessons of mentoring programs

REPORT ON THE EFFECTIVENESS OF TECHNOLOGY IN SCHOOLS 1990-1992.
Interactive Educational Systems Design (1993)
This document is a summary of research findings to justify particular approaches and applications of technology in education, including:
- effects of technology on student achievement
- effects of technology on student attitudes about learning
- effects of technology on interactions with teachers and students

ACCOMPLISHED TEACHERS - INTEGRATING COMPUTERS INTO CLASSROOM PRACTICE. Hadley
Martha and Sheingold, Karen (1990)
Bank Street College of Education
Center for Children and Technology
610 West 112th Street
New York, NY 10025

A summary of results from a nationwide survey of teachers experienced at integrating computers into teaching, and findings include:
- practices of currently available technology
- value of technology practices

EDUCATOR'S GUIDE FOR EVALUATING EDUCATIONAL TECHNOLOGY PROGRAMS
Cradler, J.D. (1992)
Educational Support Systems
1505 Black Mountain Road
Hillsborough, CA 94010
(415) 344-7046 FAX (415) 344-3604

This handbook provides valuable information to planners on:
- benefits of and reasons to evaluate technology projects
- evaluation defined in user friendly terms
- how to develop and implement an evaluation plan
- over 50 sources of evaluation data
- evaluation instruments and planning forms
- evaluating software and hardware

13 . Funding Guides

A review of funding guidebooks and documents containing sources of funding for technology will provide ideas for developing, implementing and funding technology

programs and determine possible financial support.

EDUCATOR'S GUIDE FOR DEVELOPING AND FUNDING EDUCATIONAL TECHNOLOGY SOLUTIONS
Cradler, J.D. and Cordón-Cradler, Ruthmary (1994)
Educational Support Systems
1505 Black Mountain Road
Hillsborough, CA 94010
(415) 344-7046 FAX (415) 344-3604

This guidebook takes educators through the proposal process to include:
- the process of proposal planning
- identifying funding sources
- proposal development and writing
- project development.
- visiting model technology schools
- a sample proposal evaluation report.

THE USDLA FUNDING SOURCE BOOK FOR DISTANCE LEARNING AND EDUCATIONAL TECHNOLOGY
Krebs, Arlene (1991)
39 Plaza Street
Brooklyn, NY 11217
(718) 857-3717
(800) 829-3400

The USDLA Funding Source Book is a publication listing hundreds of funding sources for technology

DIRECTORY OF BUILDING AND EQUIPMENT GRANTS
Research Grant Guides
Department 3A
P.O. Box 4970
Margate, FL 33063
(305) 753-1754

This directory lists:
- funding sources for equipment, building, and renovation
- innovative procedures to secure funding for computers and free computer software

FEDERAL REGISTER
Superintendent of Documents
U.S. Government Printing Office
Washington, DC 20402

This daily publication contains:
- notices of new grants from federal agencies
- grant application guidelines
- regulations and requirements for federal grant programs

14 . Student Information Resources

Following are suggested resources for issues to consider when planning for a statewide education information system.

CALIFORNIA STUDENT INFORMATION SERVICE
Kathleen Barfield
Far West Laboratory
730 Harrison Street
San Francisco, CA 94107
(415) 565-3055
Student information network system to assist in school/district management and the transfer of student records

CORE DATA ELEMENTS FOR ADMINISTRATIVE RECORD SYSTEMS.
National Education Goals Panel (1993)
National Education Goals Panel
1850 M Street, NW, Suite 270
Washington, DC 20036
(202) 632-0952 (202) 632-0957
This document from the National Education Goals Panel includes recommendations for an administrative record systems to measure progress toward the National Education Goals.

STATEWIDE STUDENT RECORD SYSTEMS: CURRENT STATUS AND FUTURE TRENDS
Phallas, Aaron (1992)
National Education Goals Panel
1850 M Street, NW, Suite 270 Washington, DC 20036
(202) 632-0952 (202) 632-0957

This report is a compendium of current state practices and plans for the development of voluntary student record systems to measure progress toward the National Education Goal 2.

ISSUES IN EDUCATIONAL DATA CONFIDENTIALITY AND ACCESS

87

O'Brien, Eileen and Pechman, Ellen (1994)
National Center for Education Statistics
555 New Jersey Avenue, NW
Washington, DC 20208-5651
Policy Studies Associates, Inc.
This study of the National Center for Education Statistics and the National Forum on Education Statistics reviews new issues regarding data confidentiality and access to student information.

GOAL 2 TECHNICAL PLANNING SUBGROUP ON CORE DATA ELEMENTS
National Education Goals Panel (1993)
National Education Goals Panel
1850 M Street, NW, Suite 270
Washington, DC 20036
(202) 632-0952 (202) 632-0957
This document describes indicators of goal outcomes and proposes a set of data elements and definitions that could be used to compute indicators of progress toward the National Education Goals, as well as serving needs of local and state education agencies for effective school management.

15 . Journals, Magazines, and Newsletters

Journals, Magazines, and Newsletters can be helpful to the technology planner in maintaining awareness of emerging trends and technologies, activities, and funding. Following are some samples.

EDUCATION TECHNOLOGY NEWS
BPI
951 Pershing Drive
Silver Spring, MD 20910-4464
This newsletter contains information on Federal legislation, state activities, new products and services, and funding.

EDUCATION FUNDING NEWS
Education Funding Research Council
1611 North Kent Street, Suite 508
Arlington, VA 22209.
A newsletter that monitors federal legislation with potential funding and Federal Register/RFP watch.

EDUCATION COMPUTER NEWS
Capitol Publications, Inc.
1300 North 17th Street
P.O. Box 9672
Arlington, VA 22209

This short newsletter is packed with resource information, feature articles on research, exemplary programs, and state and Federal information. Because ECN is published bi-weekly, the information is timely and up to date.

MULTIMEDIA SCHOOLS
Online, Inc.
462 Danbury Road
Wilton, CT 06897-2126
(800) 248-8466 FAX (203) 761-1444
A technical how-to magazine on electronic information to serve as a practical guide to database selection, search strategies, hardware and software evaluation, and information management.

DISTANCE EDUCATION AND TECHNOLOGY NEWSLETTER
Distance Education Publications
RFD #2, Box 7290, #3
Winthrop, ME 04362
(207) 395-4615

Provides general "happenings" in distance education activities nationwide, research and resources, and funding updates.

ELECTRONIC LEARNING
Scholastic, Inc.
P.O. Box 3797
Boulder, CO 80322-3797

Eight issues per year. This popular publication covers important issues related to the uses of computers in education. It also has state-by-state surveys of information, trends, and general industry information.

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Appendices

A. Telemation Evaluation Final Report Executive Summary

B. Glossary

C. Stories of People Using Computer Networking for Learning

   1. Examples from the U.S. Department of Education

   2. Telemation Teacher-developed Projects

D. Participants in FWL Survey of Staff Development and Technology

E. World Wide Web Hotlist for Educators

F. Additional Reading Material

Appendix A: Telemation Evaluation Final Report Executive Summary

EXECUTIVE SUMMARY

A. GENERAL BACKGROUND

Far West Laboratory for Educational Research and Development was contracted by the California Department of Education (CDE) to conduct a two-pronged study of telecommunications usage in education settings. One component consists of an overview of current research and practice on the policy, planning, implementation, and teacher staff development of telecommunications and technology in K-12 education, and is provided in a separate report.

The second component (and the basis of this report) consists of a comprehensive evaluation of the project known as "Telemation," a statewide effort begun in 1993 to equip educators and administrators with the skills and knowledge necessary to successfully use telecommunications technology in support of teaching and learning.

This executive summary provides an overview of the Telemation evaluation, highlights some of the major findings and implications, and offers a set of recommendations for consideration by project leaders and policy-makers.

B. EVALUATION OVERVIEW

The purpose of the evaluation was two-fold:

1. to document and describe the implementation of the Telemation Project, and
2. to assess the impact of the Telemation Project on the various constituent groups it was designed to serve.

The evaluation questions focused on five major areas of inquiry:

A. *Organizational Structures, Participants, and Partners:* How was the Telemation Project structured to support its goals?

B. *Implementation and Follow-up Resource Assessment:* What did and did not occur in the course of conducting the Telemation Project?

C. *Training and Support Assessment:* How satisfied were State and Local Telementors and administrators with the Project's activities and follow-up support?

D. *Impact on Teachers, Students, and the School:* What have been the effects of the Telemation Project on teachers and other school staff members, on students, and on the larger school community?

E. *Overall Reactions to the Telemation Program:* To what extent do key players and participants view the overall Telemation Project as effective and worth the cost and effort?

The design of the evaluation combined both quantitative and qualitative methods to provide a comprehensive description and assessment of these issues.

C. SUMMARY OF MAJOR FINDINGS IMPLICATIONS AND RECOMMENDATIONS

1. The process for recruiting and selecting the State and Local Telementors was seen as particularly effective in producing groups of highly motivated and competent telecommunications resource staff. Three criteria were emphasized in the selection process: 1) solid teaching background, 2) strong group facilitation or staff development skills, and 3) expertise in telecommunications, though the latter was viewed to be of lesser importance than the first two. The assumption was that if telecommunications technology is to be used effectively as a tool to support teaching and learning, then the skills that are most critical for resource staff are those that pertain to sound instruction, as opposed to solely technical skills. This approach stands in contrast to many other technology-based staff development programs which have gone about the process from the opposite direction. That is, many other programs have tended to emphasize technological expertise over instructional skill when selecting and training participants.

Recommendation(s):

- *When selecting individuals whose role is to promote the effective use of telecommunications to support instruction, maintain the emphasis stressed by the Telemation Project by making sound instructional and staff development skills a prerequisite and prior telecommunications experience optional.*

2. There was some inconsistency and confusion regarding the role to be played by the Regional Partners. Interagency collaboration was seen as key to the success of the project, and indeed many benefits were realized from the partnerships that were created. However, the difficulties and misunderstandings that arose along the way suggest that effective interagency collaboration does not occur automatically when diverse individuals gather together. Much up-front and ongoing work and communication is required in order for a solid basis of mutual understanding and expectations to be built.

Recommendation(s):

- *When forming interagency partnerships, take time early in the process to clarify specific roles and expectations, and put those understandings in writing.*

- *Revisit agreed-upon roles and expectations periodically to ensure their continued relevance and acceptability. This is especially necessary in those instances in which there has been turnover among the original key players who formed the initial agreements.*

3. The degree of participation in the project by administrators was fairly low, yet those who did participate were satisfied with their involvement, and their support was valued by the participating teachers. Since the emphasis of the Telemation Project was on involving teachers, understandably less time and energy was devoted to the process of recruiting and training administrators. However, many participants indicated that the support and involvement of administrators is crucial to their ongoing success in securing and using telecommunications resources in the classroom, and participants were strongly in favor of more awareness-building and training activities aimed at local administrators.

Recommendation(s):

- *Design and conduct telecommunications awareness-building and training activities geared toward school administrators.*

- *When recruiting for or marketing such activities, emphasize administrators' own felt needs in addition to describing the benefits likely to be gained by teachers and/or students.*

4. Local sites' follow-through on the commitment to provide Telementors with the necessary access to telecommunications equipment and resources was inconsistent. Every Telementor was required to provide assurances of their local site's commitment to provide necessary telecommunications resources, and in most cases there were no problems. However, nearly 20% of the Local Telementors responding to the survey indicated that they could not implement their curriculum projects back in the classroom because they did not have the necessary access to equipment and telecommunications resources.

Recommendation(s):

- *When conducting a telecommunications training program for teachers aimed at effecting change in the classroom, either require more stringent assurances up-front regarding participants' access to necessary resources, or*

- *if possible, build in project resources that can be used to subsidize or support the procurement of local telecommunications resources.*

5. Limited funding for telecommunications was seen as a significant barrier both to initiating and maintaining the use of telecommunications technology to support teaching and learning. Less than half of the State and Local Telementors indicated that their school had monies that were specifically earmarked for technology, and increased funding was seen by many as an urgent need with respect to ensuring the continued use of educational telecommunications in the classroom.

Recommendation(s):

- *Assist administrators and teachers in the identification of supplementary funding sources and/or in effective strategies for re-allocating existing resources such as school improvement funds, block grants, and other sources to support the use of telecommunications.*

- *Offer direct or indirect support for procuring additional technology funding (e.g., grant-writing assistance, consultation, referral to outside resources or technical assistance entities).*

6. Technical difficulties associated with the TeleLearning Mobile Unit (TMU) at times threatened the viability of the project. Central to the conduct of the Telemation Project was the use of the TMU, a semi-truck equipped with 24 computer workstations and a satellite connection. Ideally, all Local Training Institutes were to occur in this vehicle, thereby ensuring equal access to necessary telecommunications equipment across participants from all regions of the state. However, there were numerous instances of technical breakdowns and malfunctions with the net result ranging from mild frustration and plan changes to exasperation and thwarted training efforts.

Recommendation(s):

- *In designing future projects which rely heavily, as Telemation did, on a particular piece of equipment, pilot-test the use of that equipment first on a smaller scale, or*

- *Pace implementation such that there is time to trouble-shoot and eliminate problems between program phases.*

- *If the TMU continues to be used in the future, provide for adequate on-site technical support.*

- *If the TMU continues to be used, ensure that all trainings of State Telementors include alternative "back-up" activities and arrangements in the event of technical difficulties.*

- *Provide additional technical training to Telementors or others who would use the TMU as a training facility so that they would be better equipped to trouble-shoot and handle technical difficulties on their own.*

7. Despite the technical and other difficulties that occurred, most State Telementors and responding Local Telementors were satisfied with the training experience and felt that it prepared them well for integrating telecommunications into instruction. Telementors valued the project's overall emphasis on curriculum and instruction, though they desired less time devoted to these issues during actual training. Additionally, participants valued the on-line exploration opportunities, though some of the less technically-versed felt at times overwhelmed.

Recommendation(s):

- *Continue and expand the existing training time devoted to on-line exploration, but provide participants with additional step-by-step handouts to help guide that exploration and reduce confusion.*

- *Continue to emphasize the importance of using telecommunications in support of curriculum and instruction, but devote less lecture time during training to those issues. Instead, discuss instructional issues in context as they arise specifically in connection with designing the curriculum projects.*

- *Consider dividing trainees into high- and not-so-high technology ability groups, to allow those with more experience to move ahead without overwhelming those who need a slower pace.*

8. Requiring all Telementors to design a telecommunications curriculum project and implement it within their own classrooms provided a vehicle for the effective integration of telecommunications to improve teaching and learning. These projects provided a context and focus for participants to put into practice what they were learning, and the Telementors felt they experienced a great deal of success in doing so. Moreover, almost all of them expressed a willingness and interest in expanding these projects and in helping other teachers to adopt or adapt them.

Recommendation(s):

- *Continue requiring participants in this or similar staff development programs to develop specific curriculum projects that help teachers focus and target the use of telecommunication tools and resources to support state and local curriculum objectives.*

- *Provide Telementors with formal or informal opportunities to reflect on their learnings and continue to improve on or expand their curriculum projects.*

- *Develop means to facilitate communication, collaboration, and technical assistance between existing Telementors and other teachers who might wish to adopt or adapt Telementors' curriculum projects.*

9. As a result of the Telemation Project, most teachers reported positive outcomes for students and staff. Survey results, interviews, and open-ended written comments pointed to a number of very positive impacts and outcomes for a variety of constituents. Conclusions can be drawn only tentatively, however, given the self-report nature of the data itself. To draw more firm conclusions, more information is needed.

Recommendation(s):

- *Conduct follow-up study and analysis of the impact of the Telemation "Curriculum Projects" on the student outcomes intended to result from these projects.*
- *Follow up with non-respondents, i.e., those Telementors, administrators, and partners who did not respond to the surveys, in order to ensure a balanced perspective across all participants.*
- *In designing future evaluations of projects such as Telemation, employ methods that can shed more light on the links between training and teacher behavior, and between changed teacher behavior and student outcomes.*

10. Preliminary results of the State and Local Telementors' project-based teaching approach affected improvement in student outcomes. The Telementors were asked to rate the change in their students' performance on a variety of indicators including report card grades, telecommunications use, interest in school, problem solving skills, class participation, and others. Because most of the Telementors were in the beginning stages of their projects, the findings are tentative. However, observations and anecdotal evidence were suggestive of strong, positive student outcomes.

Recommendation(s):

- *Follow-up with the collection of student-outcome data as Telementors complete their projects to determine the level of student impact.*
- *Future evaluations of Telemation should include more comprehensive student outcome measurements.*
- *Telementors' curriculum projects should be expanded to include student assessment indicators.*

11. E-mail appeared to be useful and effective communications vehicle among the Telementors. Almost all of the Telementors used the e-mail on a regular basis among themselves, as well as with project leadership. Usage fluctuated during the course of the school year, with heaviest usage corresponding to heaviest periods of curriculum project implementation.

Recommendation(s):

- *Continue to track use of the e-mail system to determine usage, costs, and benefits.*
- *Explore the possibility of Telementor Institute participant follow-up support via e-mail.*

D. KEY FEATURES OF THE APPROACH AND IMPLICATIONS FOR FUTURE PLANNING

Telemation offers a model approach for building the local capacity of teachers to effectively utilize telecommunications and integrate information resources and communications opportunities into teaching and learning. Following is a brief discussion of each of these features followed by a recommendation to consider in developing a system to provide needed staff development and technical assistance for the educational application of telecommunications.

• **Multi-tiered mentoring.** The Telemation Project capitalizes on the benefits of using practicing teachers to provide the training and technical assistance to support classroom integration of telecommunications. The selection of regional or State Telementors who are organized to train Local Telementors who in turn train local teachers is an effective model to consider when designing a large-scale staff development program.

Recommendation:

Establish a process for the selection, training, and support of teachers to serve as mentors at the regional, school, and classroom level to train and support the local integration of telecommunications into teaching and learning.

• **Regional organizational structure.** It is clear that regional agencies such as county offices of education, the California Technology Assistance Project (CTAP), and other regional entities must play an active role in helping to select, train, and develop the curriculum-based training for the Telementors. The regional structures are critical to providing ongoing management and monitoring, as well as technical support to help ensure that teachers are connected to the network and have access to support resources.

Recommendation:

Utilize the resources of the existing organizational structures in the state including the Department of Education, the County Offices of Education, and other existing agencies to actively support the coordinated design and implementation of the staff development program .

• **Business and organizational partnerships.** Telemation was initiated with the concept of leveraging resources from as many partners as possible. Partners consisted of the stakeholders and agencies that offered support for project implementation.

Recommendation:

> *Actively involve a wide variety of business and organizational partners to plan, support, expand and advocate for the Telementor program.*

• **Project-based teaching approach.** The use of the "Curriculum Projects" developed by each of the participating State and Local Telementors was a critical program factor. The decision to apply this model was based on previous research conducted on the California Model Technology Schools, and the projects provided teachers with a reason to use the technology.

Recommendation:

> *Ensure that teachers (and/or teacher teams) develop specific and instructionally meaningful use for the telecommunication tools, resources, and related technologies through their own development of "Curriculum Projects."*

• **Tying Telecommunications Use to curriculum.** Often telecommunications is employed without attention to the specific integration of the technology to support both current and emerging curriculum reforms and initiatives. In these cases research shows that technology use is either not sustained, or fails to produce valuable contribution to teaching and learning.

Recommendation:

> *The planning and implementation of telecommunications tools and resources should be closely tied to state and local curriculum priorities and to students' instructional needs.*

• **Linking lessons learned to future planning.** The evaluation of Telemation concluded that the program and approach was well worth the funding expended for the program. However, there are many lessons learned in the efforts to develop and implement a large scale program to provide needed staff development and support for effective telecommunications use. The suggestions that emerged from this study should be used to inform and guide future efforts to implement and/ or scale up this program or similar programs.

Recommendation:

> *Utilize the results of this study to inform future planning and adaptation of the major elements of Telemation.*

Appendix B: Glossary

Appendix B: Glossary

Analog communication — A communication format in which information is transmitted by modulating a continuous signal, such as a radio wave. Voice and video messages originate in analog form since sound and light are wavelike functions; thus, they must be converted into digital messages in order to communicate along digital communications formats or media.

Application tools — Computer software that enables the user to manipulate information to create documents or reports.

ASCII — The American Standard for computer Information Interchange (pronounced "as-key") provides a numeric code for all the characters available using a standard keyboard. This code is common among all computers in this country (and in many other parts of the world), thus data in ASCII format is compatible with nearly every computer system and eases the process of sharing it with other computers.

Asynchronous communication — Two-way communication in which there is a time delay between when a message is sent and when it is received. Examples include electronic-mail and voice-mail systems. In contrast, synchronous communication is simultaneous two-way exchange of information, for example, a telephone conversation.

Attached file — An e-mail message can have another file document, of any nature, (graphics, text, animation, sound) "attached" and sent with the e-mail message.

Asynchronous communication — A conferencing system that can transmit audio and still-video signals, computer graphics, and text on the same telephone cable or other narrowband communications channel. Equipment generally included computers, graphics cables, and speaker phones at both the receiving and delivering ends.

Backbone — The main communication channel in a network wiring scheme, so called because other communications lines connect to it like ribs connect to the human body's backbone.

Baud (baud rate) — Rate of character transmission over communication devices such as printers, terminal and modems. Baud rate is the number of signal changes per second; which may, or may not, be the same as the number of bits transmitted per second. It is named for Emil Baudot, a pioneer in printing telegraphy.

Bandwidth — A measure of information-carrying capability. The difference between the lowest and highest signal frequency is expressed in hertz (cycles per second). Wider bandwidths can carry more information.

Broadband — A flexible, all-purpose, two-way medium that provides the wide bandwidth necessary for both conventional video and high-definition television, and for still-frame displays for information retrieval, catalog shopping, and so on.

Bulletin board service (BBS) A computer service that is modeled after a community bulletin board. Using a computer, modem, and phone line, individuals connect to a central "host" computer to post or read messages or to upload and download software. Communication is usually asynchronous.

Cable television system (CATV) A broadband communications system capable of delivering multiple channels of programming from a set of centralized satellite and off-air antennae, usually by coaxial cable, to a community. Many cable television systems combine microwave and fiberoptic technologies

Capacity Amount of data that can be stored in computer's memory, or on a storage device such as a hard disk, diskette drive or CD-ROM. It is usually describe in terms of megabytes (MB), where 1 MB equals 1,048,576 bytes.

Computer-aided instruction (CAI) A broadband communications system capable of delivering multiple channels of programming from a set of centralized satellite and off-air antennae, usually by coaxial cable, to a community. Many cable television systems combine microwave and fiberoptic technologies

CD-ROM This technology has been rapidly evolving and will continue to do so in the coming years. An acronym for Compact Disk-Read Only Memory, these data storage devices are capable of storing vast amounts of data on laser disks quite similar to the audio compact disks that are now popular. As with audio disks, the process of writing these disks is a highly specialized process, and each disk can be written just once. Therefore, CD-ROM's are used for storing large volumes of data that are relatively static and do not change frequently. Some applications include storage of reference libraries, including encyclopedias and legal volumes.

Chat Whenever a number of people are simultaneously connected to a telecommunication service, they may chat, or type messages to one another, in real time.

Compatibility The ability of one computer to accept and process data in the same manner as another computer without modifying the data or the media upon which it is being transferred. Capability of connection to, or communication with, another system or component.

Coaxial cable Shielded wire cable that connects communications components. Coaxial cable is commonly used in cable television systems because of is carry multiple video (or other broadband) signals.

Codec An electronic device that converts analog video signals into a digital format for transmission, and vice versa. The name is an abbreviation for "coder-decoder" or "compressor-decompressor" when compression is also involved.

Compression Compressing information so that it requires less space to store or transmit. When speech is compressed, for example, pauses are eliminated. Compression is generally expressed as a ratio.

Download	The process of transferring data to a local computer from a remote "host" computer that is located elsewhere, using modems and phone lines to "connect" the computers electronically.
E-Mail	Electronic mail is private mail sent from one computer to another. E-mail can be sent to multiple recipients, carbon-copy recipients, and blind-carbon-copy recipients. It can be replied to and forwarded and even include attached files.
Emoticons	Characters, mostly consisting of punctuation, which can be viewed sideways, and which give information on the writers emotional state. The symbol :) is a smile, ((((name)))) is giving someone a hug.
Expanded Memory	Memory beyond the standard 640 kilobytes of the computer's memory, which is used according to a standard known as the Expanded Memory Specifications (EMS), developed jointly by Lotus, Intel, and Microsoft (LIM-EMS).
Extended Memory	Memory above 1 MB. Many MS-DOS applications require that this memory is configured as expanded memory or as a virtual disk. Some operating systems and applications can use extended memory directly through the eXtended Memory Specifications (XMS).
Gateway	Connections made from one telecommunication service to another through the Internet are called gateways.
Home Page	A person or a business opens an individual account or category on the Internet to provide services to other people or businesses.
Information Highway	The generic term used for the Internet.
ISDN	Integrated Service Digital Network (ISDN) offers a worldwide network capable of transmitting voice, data, video, and graphics in digital form at the same time. This technology provides services cheaper and faster than what is generally available today.
Kilobyte (KB)	1,024 bytes. Its abbreviations (K and KB) are taken from the Greek word kilo, meaning 1,000; often used to mean 1,024, or 2 raised to the 10th power. See also byte.
LAN	Local Area Network (LAN) is a term used to describe a network in one business or organization -- usually in a limited area.
Megabyte (MB)	1,048,576 bytes (1024 x 1024 bytes).
Modem	A device that allows computers to interact and interchange data with other computers over telephones lines. Most modems are also capable of sending and receiving facsimile (FAX) transmissions.
Multimedia	Multimedia hardware usually consists of CD-ROM drives, sound boards, and speakers needed to operate software such as interactive encyclopedias.

talking children's books, music, and games with high fidelity sound and animated pictures.

Online Terminology used to describe when a computer user is connected to a telecommunication system via modem.

Scanners Scanners, stationary and hand held, "read" an already printed document and copy it onto a fixed disk or diskette. The simplest scanners will read all text the same - interpreting large, small, bold, and italics text as normal, 12 point type and will not read graphics (lines, boxes, line drawings, and photographs) at all. The most expensive scanners will faithfully copy everything they "see" exactly as it is printed.

Upload This is the process of transferring data from a local computer to a "host" computer over modems and telephone lines. The opposite of "download".

Video Conferencing A process by which individuals or groups can "meet" via phone lines. Both audio and visual representation of the persons involved are possible.

WAN Wide Area Network (WAN) is the terminology used when a number of networks throughout a state or country are tied together to allow easy access to common users in a business or organization.

World Wide Web The linking of millions of persons around the world using the Internet to communicate.

Appendix C: Stories of People Using Computer Networking for Learning

1. Exmples from the U.S. Department of Education

2. Telemation Teacher-developed Projects

Examples from the U.S. Department of Education

1. Centennial High School, Champaign, IL
2. Christopher Columbus Middle School, Union City, NJ
3. Pease Middle School, San Antonio, TX
4. Pittsburgh Middle School, Pittsburgh, PA
5. Florida School for the Deaf and Blind, St. Augustine, FL
6. Maryland Sailor, State of Maryland

Centennial High School
Champaign, Illinois

- Visual science experiments
- Multimedia research projects
- Writing projects

It began with four science teachers and an idea: that computer networks could be a powerful tool for teaching and learning. They didn't know how to finance additional equipment; nor did they see exactly how they would use networks in their classrooms. They knew they would need help, so they approached the National Center for Supercomputer Applications (NCSA).

Expert Help and Advice from a Neighbor

NCSA is a federally funded research laboratory located in the Champaign-Urbana area. Although its primary function is to provide scientists with access to what can only be termed the super-fast computing power of their equipment (a Cray Supercomputer), the lab's official mission includes educational and outreach activities. It assists schools anywhere in writing grants to the National Science Foundation for funding of computer programs or for the acquisition of equipment. NCSA also organizes summer workshops for teachers and maintains an E-mail address for questions from educators regarding implementation of education programs involving computers, teacher training, and grant applications.

At NCSA, the science teachers from four high schools in the Champaign-Urbana area received assistance in writing a successful grant proposal to the National Science Foundation for a joint telecomputing project with NCSA. NCSA assigned the teachers a liaison, Nora Sabelli, who worked with them on the implementation of the project.

The installation of computer equipment and network connections attracted the attention of Ameritech, the Great Lakes' regional Bell Telephone Company. The telephone company wanted to test some network equipment they hoped eventually to market. For that opportunity, Ameritech, through a grant to the University of Illinois, outfitted one of the public schools with high-density digital phone lines. Ameritech is now helping to build a community-wide network.

Science Experiments on the Computer Screen

The first telecomputing application at Centennial High School in Champaign connected the students of the Advanced Chemistry class with the supercomputer at NCSA. This was welcome news for Centennial, as some natural physical reactions, such as those inside molecules, can be modelled mathematically only with a complex and lengthy series of calculations. The supercomputer allowed students to design and conduct their own experiments and watch parts of molecules move on their computer screens, in response to their own computer commands. In one type of simulation, students watch the orbitals of models their shape, number, or speed in reaction to imposed actions. Another type of simulation demonstrates the ionization of atoms how the size of atoms changes when ions are added or subtracted.

Such simulations of molecular behavior provides interactive learning rather than one- way presentation. Each student decides which atoms to use and what type of action to initiate. Since scientists developed the molecular simulation programs for their own research needs, whenever a Centennial High School student uses the program, he or she is imitating the behavior of scientists at work.

More recently, the NCSA has also written simulation programs in physics and mathematics.

Other Telecomputing Applications and Increased Use

The second telecomputing application at Centennial High School incorporates multimedia software (such as HyperCard and Mosaic), Gopher search software (Gopher finds files within libraries of files), and data bases from all over the world, containing text, pictures, and even music. A student conducting a research project on a Shakespearean play, for example, reads text from Henry V, views artists' renderings of the English king drawn in the king's time, and listens to music composed in Henry's era.

In the first year, 30 Advanced Chemistry students used computer network applications. Now, over 100 students in chemistry and other courses have access to the computer lab and use the networks for some school projects. Soon, students in all of the regular chemistry courses will use the supercomputer simulation programs over the network. Centennial High School also plans to connect to the network all of the Macintosh computers they use for their English courses, which start in the students' freshman year. (All students take the English courses.)

Still more students use the network before and after school to pursue their own interests and projects. The computer lab is open a few hours after regular class hours, and students can be found there until closing time. As one grant tends to attract others, one successful telecomputing application attracts imitators. Telecomputing in the Champaign Public Schools now interests even the previously skeptical. It was natural that science teachers initiated the first telecomputing application. They had considerable experience with computers and understood their own capabilities as learning tools. Once they successfully implemented their telecomputing program, they were free to help other teachers do the same.

Glitches

Some teachers like telecomputing, particularly those who readily see its usefulness. Other teachers and some administrators believe money for telecomputing might better be spent on other programs. For the financial administrators especially, some of the added expense of telecomputing that which is not covered by outside grants is subtracted from their budget's bottom line, which makes them uncomfortable.

The Future

According to former science teacher Barry Rowe, the parents who voice an opinion on the telecomputing innovations are universally enthusiastic about telecomputing. Some, in fact, worry that if their children do not learn telecomputing, they will be disadvantaged throughout their lives. In fact, it is often parents who provide the primary motivation for the adoption of telecomputing in a school. Schools get wired for network connections through parents' financial contributions or through parents' insistence that the school be wired. The Champaign Public School District is now in the process of integrating all its schools into a network.

The Champaign Public School District is now in the process of conducting a formal evaluation of their telecomputing programs, complete with objective outcome measures. Informally, though, the program has generated great enthusiasm among students and much interest among teachers and parents.

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Christopher Columbus Middle School
Union City, New Jersey

- Schoolwide curriculum change
- Linking school and home
- Small group collaborative learning
- International correspondence

The Union City school district was on the verge of being taken over by the state. This densely populated, poor, urban, Latino school district with 60,000 residents packed within one square mile had difficulty meeting New Jersey State education goals. Student attendance and scores on standardized tests were below state averages, while dropout and transfer rates were far above the state norm.

All that began to change in the 1989-90 school year. A new district superintendent and a new executive director for academic programs were appointed, and, because of the district's poor academic track record, the state required Union City to develop a five-year restructuring plan. As a result, teachers developed a new interdisciplinary curriculum for grades K-8 that emphasized research, learning by doing, cooperative learning, and the reading of challenging literature.

Other reform activities included changes in class schedules, with (a) extended block periods in communication and math and science, (b) the elimination of pull-out programs, and (c) more emphasis on staff development. With additional money from New Jersey's Quality of Education Act, the district made a significant investment in technology resources. In the last four years, for example, 775 computers were installed.

At the same time district reforms were taking place, the school district extended feelers to business and industry in New Jersey, hoping to convince those communities to invest resources in the schools. Initially there were no takers. However, Bell Atlantic looking to test a communications system in an inner city, minority school district with a dense population spotted the district's call for investment and decided that Union City was a match. The school district was renovating an old parochial school it had recently purchased to house seventh and eighth graders from two elementary schools that were overcrowded. During renovations, a state-of-the-art networking infrastructure could easily be installed, and in 1992, Bell Atlantic approached the school district and offered to implement a technology trial. It was an offer the district could not refuse.

Wiring Up

While the two-year project at Christopher Columbus Middle School began in September of 1993, planning had been underway for about a year. In the summer of 1993, Bell Atlantic installed in the school and homes of all seventh grade students and their teachers 486-level computers equipped with graphics and voice capabilities. The computers are tied into a local area network that is itself connected to a wide area network, users can communicate between school and home and have basic software tools to carry out curriculum activities.

Students and teachers are encouraged to keep the computers over the summer; and the computers supplied by Bell Atlantic now supplement the ones already purchased by the school district. In addition to each classroom having several computers, there are computers in the media resource room, the science laboratory, and the computer laboratory, all areas to which students have access. The media resource room and the computer lab also have a large collection of software programs; and the teacher's room, too, is equipped with computers.

Technology and the Curriculum

Administrators and teachers now see the technology as an integral part of the curriculum, as it fits in well with their emphasis on research, critical thinking, and cooperative learning. For example, when students study the American Revolution, the teacher has them conduct research that they later share with the class. The teacher also can divide the class into research teams. One or two teams conduct their research through

traditional information, such as textbooks; another team goes to the media center and researches the topic on the Grolier multimedia encyclopedia; a third team uses the computer to research the topic through a CD ROM information disc; and a fourth group uses E-mail to access other forums or groups that may have information on the Revolution.

In their communications class, students can choose a novel to read and research novels written about bravery and the Revolution. In math, they can make pie and bar graphs to compare, say, British and American resources available during the Revolution. Teams that do not complete their work during class time can continue working at home and communicate with one another through E-mail. Student teams then write group reports on the computer, which they present to the class to establish class knowledge.

Support is the Critical Factor

One sometimes hears that teachers fear technology, but not at Christopher Columbus Middle School. Teachers at the new school had volunteered for the assignment. Their enthusiasm was supported by training they received from Bell Atlantic and from the Education Development Center's Center for Children and Technology.

Before the school year began, teachers learned computer basics and how to plug in multimedia applications to the new Union City seventh and eighth grade curriculums. They received training in how to manage files, use Microsoft Works and Microsoft Publisher, and generate applications using KidPix. Training continued through the school year, so that teachers learned how to use spreadsheets and database applications, E-mail, Lotus Notes, and Internet. The Center for Children and Technology also worked with teachers interested in discussing various technical and curricular issues that arose out of their work with Project Explore.

Teachers held two workshops to introduce parents to the new technology; and Bell Atlantic staff are currently in the process of setting up parent accounts on the network. The project had the support of the principal, who provided strong leadership and gave parents, students, and teachers an active voice in the decision-making process.

Glitches

Installing the technology is complex, and it is complicated by scheduling and coordinating the lines in students' homes and the school. Furthermore, it is more time consuming to maintain the computers and the network than Bell Atlantic initially anticipated.

Some teachers feel students might benefit from more software to help them develop and practice basic skills; others want bilingual software. Administrators want more educational tools to enhance the curriculum content. In Phase II of the project, beginning in September of 1994, a CD ROM library will be introduced to fulfill some of these desires.

Administrators raised some concern that the two-year length of this project may be too short a period for teachers to become comfortable with the new technology. Thinking about their students' future, administrators also are concerned that Christopher Columbus graduates, accustomed to working with technology, will be frustrated and constrained by the lack of resources they may discover at home and in their high schools.

The Future

Reforms initiated by the district have had a positive impact. Collaboration has become the norm among teachers, administrators, and parents using the network; and parents, teachers, and administrators are working toward establishing a school-improvement team.

When compared to national averages, Union City students in grades K-8 are performing in the average to above average range in reading and language arts, and to the above average to best range in mathematics. On New Jersey's Early Warning Test, which measures eighth graders' knowledge and skills in reading, math, and writing, students in Union City are outperforming other urban and special needs districts in the state by approximately 10 percentage points.

In fact, on the practice Early Warning Test taken by seventh graders, students at Christopher Columbus had the highest overall scores of any students in the district. According to the Director of Academic Programs, these higher scores can be partially attributed to the amount of writing and editing that students are doing on the computers at the school and at home. Christopher Columbus also holds the district's best attendance record for both students and faculty.

While the transfer rate in the district has declined overall, it dropped significantly at Christopher Columbus. Students are using the media resource room during lunch time and after school. They're actually eager to hand in their homework, neatly typed on the computer. And they're lining up before the formal school day begins so that they can get into the building eager to continue their learning activities.

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Pease Middle School
San Antonio, Texas

- Scientist mentoring
- Student collaborative research projects
- International correspondence

The quality of air at school seemed poor, so when students at Pease Middle School were asked to select a "study site," as part of their involvement in the Global Laboratory project, they and their teacher chose their own classroom.

Armed with an air pump, air testing tubes, and other tools, students conducted a series of tests. They found no appreciable sulfur dioxide, ozone, or carbon monoxide levels in their classroom; however, carbon dioxide levels consistently exceeded the recommended limit of 1000 parts per million set by ASHRAE (American Society of Heating, Refrigerating and Air Conditioning Engineers).

Mindful of complaints about poor air quality throughout the school, the students conducted a broad survey of air quality and sought the opinions of the faculty. Equipped with their air testing tools provided by the Global Laboratory project -- and following strict scientific protocols -- students measured CO2 levels in other classrooms and found them also unacceptably high.

The class's CO2 measurements and survey results were presented to the school board, which dispatched four environmental control officers to investigate. Linda Maston, a teacher and three-year veteran of Global Lab, used the computer network to report what ensued. She said:

> They [the officers] first went into the counseling office where the counselors and teachers told them about what was going on. They were not impressed, so they were brought to our classroom. As soon as we pulled out the data and the graphs showing the patterns that we had found, they suddenly started to take notes.

The officers decided to make readings with their professional equipment. Ms. Maston continued:

> The moment of glory came this afternoon when they showed up with the same kind of tubes we had, and their fancy pump got exactly the same reading as we had with our syringe version!

Soon, the school's ventilation system was repaired. Not only had the students conducted real scientific research, their findings had made a difference in their environment. Linda Maston concluded:

> The CO2 study was [the students'] pride and joy. They were just so pleased and proud of themselves that they had managed to do what nobody else had been able to accomplish in 17 years. To have their data taken seriously by adults in general, and the district in particular, was just awesome for them. They are so used to failure that it's hard to convince them sometimes that they're doing good work.

Telecommunications

After the Pease class made its school-wide CO2 readings, the students posted a request on the Global Lab network for CO2 readings in other classrooms.

From their colleagues in Aiken, South Carolina, the students received the following message:

> Hello San Antonio: We read your report about carbon dioxide and have a similar case here in Aiken, SC. All of our classrooms have windows but

we did a project which tried to test the carbon dioxide levels in the trailers where a lot of our classes are. Dr. Borst thought that they would have higher levels. Not!! The regular classrooms had higher levels... We explained this by the hallways.

Regular classrooms open into hallways, while the trailers open into the outdoors... So when the class changes you get fresh air in the trailers. In the regular classroom you get stale air from the hall. (Kennedy Middle School, Aiken, SC)

Scientists On-Line

When Global Lab posted on several telecommunications networks a call for on-line scientists to support air quality school research, Ken Muzal -- who works with real air quality measurements, industrial hygiene chemistry, and analytical chemistry -- offered to join.

In his e-mail message, Ken outlined the vital air quality issues on which students could focus their research. Students had already concluded that high CO2 levels were the cause of the poor air at Pease. But after exchanging e-mail messages with Ken -- and while looking at "the nature of our school, how it was built, and the pattern of CO2, levels that we had observed" -- students discovered the cause of the problem: inadequate ventilation.

Global Lab

The experience of this Global Lab class is not unique. Rather, it illustrates the kinds of activities occurring worldwide in classrooms participating in the Global Laboratory, a worldwide environmental project that fosters collaborative student research. By relying on an integrated use of several computer software programs and laboratory equipment, the project introduces classrooms to real-world investigations, technologies, communications, and collaboration all of which supports student-based research.

Global Lab is administered by TERC, a 30-year-old non-profit research organization devoted to improving math and science instruction in elementary and secondary schools. With a grant from the National Science Foundation, TERC provides a way for schools to participate in a worldwide community of student scientists investigating environmental issues. Global Lab schools also receive a collection (on CD-ROM) of curriculum, software tools, technical information; conferencing facilities to enhance collaboration with other schools around the world; and "starter kits" of materials to begin project-based explorations.

The Future

More than curriculum and technologies, the Global Laboratory is a community of students, teachers, and scientists engaged in real world, hands-on, interdisciplinary research. Unlike traditional curriculum, the project is dynamic and ongoing. In the 1993-94 school year, Global Lab students are building on the databases organized during the 1992-93 school year. These students will then establish new environmental monitoring sites at which future generations will learn and practice the diverse skills of true science.

This case study is adapted from an article written by Dr. Boris Berenfeld for the TERC publication, Hands On! (Fall 1993, Volume 16, No. 2). Dr. Boris Berenfeld is co-director of the Global Laboratory project.

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Pittsburgh Public Schools
Pittsburgh, Pennsylvania

- International correspondence
- Scientist mentors
- Teacher help line
- Research project collaboration

During a demonstration at the University of Pittsburgh, teacher Mario Zinga saw the promise of computer technology. He and several other teachers who had seen the demonstration arranged a meeting between the Assistant Superintendent and Dr. Robert Carlitz, the demonstrator from the University of Pittsburgh -- and Common Knowledge was born. Four schools initially participated in the project in 1993 two high schools and two elementary schools. These schools jumped on board because teachers or supervisors were enthusiastic about the project. In 1994, seven more schools two high schools, one middle school, and four elementary schools were selected through a competition for second-year sites.

Every school currently participating in the project has a local area network (LAN) and access to a wide area network and Internet. Three of the schools are wired throughout. At other schools, classrooms participating in the project are wired. In addition, all libraries in the schools are wired, so that students not participating in the project have the opportunity to use the network.

School Focus Areas

In one of the participating high schools, Schenley High School, the focus of the project is on foreign languages. Students use Internet to communicate in German, French, and Spanish with their "pen pals" in foreign countries.

At Westinghouse High School, where math and science are the focus, students conduct science research through Internet. The project at the school, developed in partnership with the Westinghouse Corporation, was initially designed to provide students with mentors from Westinghouse Corporation and university professors, to assist them with their research projects. Students communicate through e-mail with their mentors and use the online resources available through Internet. At the completion of their research on such topics as acid rain, oil recovery and chromium, students publish their own papers, using the school-based resources. For them, it is rewarding to see the fruits of their labors placed on the network. In addition, recognizing that it takes time to get up to speed with new technology, the project developed an internal mentoring process whereby seniors work with sophomores and juniors to help them learn the tools necessary to use the resources provided on Internet.

At the elementary school level, the focus is on contacting other individuals to contribute to a project, rather than on collecting data. In the first year, teachers joined mailing lists for online projects already in existence, and in the second year, teachers are trying to initiate activities and develop their own collaborations on such topics as the river and the weather.

Providing Support

Teachers participating in the program receive both educational and technical support. The project team trains teachers and has catalogued resources on the Internet to help teachers locate information on specific curriculum topics. In other words, the menu is determined by teachers' requests, rather than by some centralized group deciding what teachers should have.

The project team also helps students to use the tools on the network and set up network accounts. The ultimate goal is to help schools build their own expertise and give schools independence from the center. One way this has been tried is to use the network itself as a support system. For example, teachers are given an E-Mail address named TROUBLE, where they can send a message describing the problems they encounter. A team of educators, technicians, and district personnel monitors the messages, and helps teachers solve problems.

To get additional schools involved, the project team provides introductory courses that demonstrate the usefulness of the technology and how to establish the network in the classroom. To encourage more schools to compete for a grant in the coming year, the project team will help schools who request assistance to write a proposal for funding under this grant and help them articulate the school team's visions for a particular curriculum area.

Glitches

There have, of course, been some glitches along the way. For example, some school administrators suggested that the internal competitive process for awarding grants may not be equitable. Some schools that have few resources feel they should automatically be awarded a grant. Still others feel that the selection process should be less competitive, so as to prevent schools from becoming losers.

The project aims to make the technology and resources of the Internet an essential part of instructional and administrative work at the Pittsburgh Public Schools. But, some district administrative staff members are concerned that they have not participated closely enough in the implementation process. Some district staff remain afraid of technological change and worried about how the project will affect them. Others are concerned about spending finite district resources on such new technology.

Although many teachers are ready for change, some fear technology or are unwilling to experiment with the network. Another issue that seems to have emerged among teachers is how to organize the classroom. The traditional 40-minute class periods, textbooks, and standardized tests, do not easily accommodate the problem-solving, research-oriented thrust provided through the project. Alternatives must be explored.

The Future

The school district is in the process of developing a five-year technology plan that will tie in the technology to the major priorities of the school district and link technology with standards set by the state. In concrete terms, three schools will be added to the project by 1995, and it is hoped that by 1997, 32 schools will have access to Internet.

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Florida School for the Deaf and Blind
St. Augustine, Florida

- Telecomputing adaptations for those who are blind
- Telecomputing adaptations for those who are deaf

Training teachers to use computer technology is the cornerstone of the Florida School for the Deaf and Blind's technology program, says John Mark Leach, Coordinator of Computer Resources.

Teachers using computers in their classrooms take 40 hours of inservice training in their first year and 20 hours in their second year. The school contracts with experienced individuals to conduct the training and also uses an expert mentor model, with more experienced teachers helping the less experienced. With a faculty of approximately 130 teachers, over 90 percent have participated in technology inservice programs.

Computers were introduced in 1983 in this K-12 residential school, which serves approximately 610 students who are blind, deaf, or have special needs. For all of these students, computer technology is used in various ways. For those who are blind, for example, it is used primarily as a means of extending communication. For students who are deaf, it is used as a springboard to build concepts for written language. For students with special needs other than blindness or deafness, it is used more for instruction (such as review of basic skills) and language development.

All equipment used in the school is purchased through special funds. As a state institution, the school has received grants from the state legislature to purchase equipment; and over the last eight years, the school received two grants from Apple Computer to purchase equipment and to conduct training. In addition, a private foundation supports the purchase of some of the equipment.

The school is now in the process of being retrofitted to handle new technology. The institute received one $200,000 grant from the state to retrofit four of the major buildings; and recently they applied for a second grant. Since the school is made up of a complex of buildings, it will take some time to wire the entire institution. However, this year, almost every classroom has at least one computer. The school also has equipped two language arts classrooms (one in the deaf high school and one in the blind high school) with at least six networked computers for total integration of technology throughout its curriculum. In addition, each classroom has a modem with access to the FIRN (Florida Information Resource Network) and, of course, the Internet.

Blind and Low-Vision Population

When computers were first introduced to students who are blind, staff began experimenting with word processing capabilities. Within a short time, they realized that computers provided a way for students who are blind to break out of their isolation and communicate with people in the community they would not otherwise have access to.

In first grade, students who are blind are introduced to basic keyboarding skills. Usually by third grade, they begin learning how to use software to telecommunicate. They start by learning how to communicate with one another, then branch out to a local bulletin board within the community, which enables them to talk with other people outside the school. (One student developed such good contacts in the community that it led to a job upon graduation.)

By the end of middle school, students become relatively fluent in the use of the network and can download files; and as experience with telecommunication increases, students begin using the Florida Information Resource Network, which gives them Internet access.

Students can take the computers home on weekends and, if parents are willing to accept responsibility for the equipment, they can take the equipment home with them over the summer. Staff noted that as more computers are going into the homes, parents are becoming more involved

and often call the school to request help in deciding what type of equipment to purchase for their children.

Telecommunications opens unseen doors for those who are totally blind. There is a world of information available to them through computers with voice synthesizers and braille impact printers. As expected, the ability to have current information literally at their fingertips has helped students who are blind become more productive. As John Mark Leach noted, An assignment that used to take students three weeks, because they had to wait for some transcribed information, can now be finished in three days.

While technology for those who are totally blind focuses primarily on facilitating communication, for students with low vision, the technology is used for both telecommunications and computer-assisted instruction. Students can use off-the-shelf instructional programs with large-print monitors and printers.

Deaf Population

Students who are deaf use technology to develop language skills. These students tend to have trouble processing written language, but, through the use of animation, video, and other software, students and teachers work cooperatively to enter new worlds of expression.

The school is integrating technology into the curriculum as well as building on students' own experiences. For example, high school students, some of whom escaped from Cuba, are building a hypermedia presentation of life in Cuba. Through a cooperative effort, students who are deaf are planning, developing, and producing a multi-media expression of their experiences to share with others.

A recent grant from Apple Computers is being used to develop a curriculum that focuses on the theme of Deaf Culture. This curriculum will give children who are deaf the opportunity to explore the richness and diversity of their own culture, and will encourage a sense of pride as well as improve their language and writing skills all through telecommunications.

Glitches

Lack of sufficient resources is a problem. There are not enough computers available and some teachers lack telephone lines to connect to the Internet.

More specifically, it is difficult to get the peripheral and software equipment needed by those who are blind. Since the market is relatively small, not enough profit motive exists to drive the development of new software. The change in technology from MS DOS to Windows also hinders accessibility for students who are blind.

The Future

Students are turned on to learning through the use of computers and are disappointed when technology is not available. For example, some middle school students were disappointed when they moved on to high schools where computers were not available. Yet, everyone seems to be looking forward to having all the school buildings retrofitted. Once completed, it will be the norm for students who are deaf and blind to easily share files and chat with one another. The school also will continue to ensure that all teachers interested in using computers receive adequate training, making the future for this experiment look bright.

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Maryland Sailor
State of Maryland

- Round-the-clock public access to public libraries
- Internet access for all schools
- Inservice training for library media specialists, teachers, and public and academic librarians

Anyone living in Maryland can board Sailor and take an electronic cruise, thanks to a project launched by Maryland's library community to provide free Internet access to state residents.

It began two years ago with 15 librarians and technicians who were interested in more effectively sharing library resources. They developed a plan to connect the state's libraries for resource sharing and Internet access. Interest spread and some 125 people from the library community became involved in all aspects of the project, from marketing and grants development to training and assessment. Included in the initial group was a library automation specialist from the University of Maryland, who brought the idea to computer experts at the university. The institution agreed to extend its telecommunication system to the library community and offered to pilot the Sailor Gopher. The university continues to provide encouragement and technical support, including a helpline, for Maryland educators.

The University of Maryland operates a bulletin board, K-12 Community Listserv, and a discussion forum that gives educators an opportunity to learn from one another. E-mail accounts are available, free of charge, to interested educators so that teachers can connect to other computers and see the kinds of information sources they have available.

Enoch Pratt Free Public Library was the first library to offer Sailor. From July 27th, when the system first went public, to August 8th, Pratt library received 90,253 calls to access Sailor. The average number of simultaneous users at any given moment was 45. When a staff member checked usage at 3 a.m. on August 1st, she found 12 electronic customers at work. Quite an extension of normal public library hours, she observed.

For a modest fee ($100 a year), people can obtain accounts that will give them access to additional Internet services.

Impact on Schools

Schools facing budget cuts are likely to benefit from Sailor. The connection with Internet provides students and teachers with a wealth of up-to-date information, such as scientific databases, economic forecasts, and newspapers and journal articles.

Library media specialists and teachers throughout the state use the telecommunication system in a variety of ways. At one elementary school, for example, students are working on a joint classroom project that connects the children to databases that review books. The project involves the purchase of new books for the school library. Working with a budget of $100, students research and make a collective decision on the selection of books. The decision-making process involves consulting reviews from children's literature databases, learning how to evaluate materials and information sources, and developing criteria for book selection. As they work through the process, students learn how to plug into information.

Another elementary school is linking students to a worldwide collaborative called KIDLINK. The project they are working on is A Day in the Life of .... Each day students record their activities and share their experiences across the network. What they are learning is that kids are more alike than different regardless of where they live.

At Eastern Technical High School in Baltimore County, Sailor is used with a variety of classes, including math, chemistry, engineering, allied health, and nursing and English. In the English class, students use Department of Commerce economic statistics to develop a realistic career plan. The students scan the Occupational Outlook Handbook, research various trades, and review current employment rates and employment projections in different job areas, in different parts of the country. Such activities help students to better understand the job market and to make more informed choices about possible careers. Students also come to the library media center on their own. Many students in this economically diverse

community do not have a modem at home, so they use the equipment before or after school, or during their lunch break.

Emphasis on Training

To acquaint them with Sailor's potential, the State Division of Library Development and Services provides awareness training for library media specialists and public and academic librarians. This awareness training has generated a grass roots movement among trainees and fostered use of the network. In addition, media specialists are forming their own user groups to share ways in which they are using the telecommunications network; and some local education agencies are providing school staff with computer and telecommunications training.

In Baltimore County, the Office of Library and Information Technology received a $55,000 grant from the U.S. Department of Education's Office of Education Research and Improvement - Library Programs to train library media specialists and public librarians on how to use electronic media sources and telecommunications. The grant, which began in January of 1994, provided funds to set up a training site at Eastern Technical High School, including the installation of 11 modems and phone lines in the library media center.

Because inservice training is provided for teachers, they are experimenting with using computer menus to narrow down the information they are searching for. In addition, supervisors, coordinators, and district-level administrators are learning how to use Internet; and administrators have started their own Internet users group.

Nancy Null, a library media specialist at Eastern Technical High School, uses the equipment to train students at the school. Students work in collaborative groups at the library computer stations and learn how to access data through telecommunications. Once they become familiar with Sailor, the students tap various sources to learn more about their assignments and interests.

Glitches

There were a few initial problems. For example, the higher-speed ISDN telephone lines required for the network were at first not available in all parts of the state. As a result, the system took longer to install than initially anticipated.

At the school level, telephone lines in the library media center didn't exist, and getting the budget and installing the phone lines was difficult in some schools. In addition, not all library media specialists are comfortable with the new technology. As a result, they are more reluctant to use the network themselves or work with teachers and students to use the network. Finally, there are times when classes come to the library media center and cannot get online because there are not enough lines. The teacher and library media specialist have to quickly change their lessons for the day.

The Future

Since training is an essential ingredient in fostering the use of the network, the State Division of Library Development and Services is developing a plan to train master library media specialists and public librarians. Two training sessions are scheduled (one in December and one in January) for a total of 40 individuals. The objective of the training plan is to have individuals serve as trainers for other librarians and media specialists in their own regions so that training will be provided throughout the state.

One of the goals of the state library division is to have Sailor recognized as Maryland's public information network. By offering network accounts through local public libraries on a cost recovery basis, the state is hoping to give any individual access to a wide range of state and local information. At the school level, a future goal is to find an economical way to link all of the schools to Internet.

Sailor's implementation through September of 1995 relies on Federal Library Services and Construction Act funds. Efforts are underway to receive state funding for Sailor's ongoing costs beginning in July of 1995.

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Telemation Teacher-developed Projects

1. Plastic Recycling and Waste Management
2. Collaborative Teamwork: Developing Multimedia Programs Using On-Line Telecommunications
3. A Virtual Treasure Hunt in Spanish-Speaking Countries

Plastic Recycling And Waste Management

by
Elliot
Barenbaum

Marina Middle School
San Francisco, CA

Subject Areas:

Environmental Science and Language Arts

Grade Levels: **7 - 12**

Length of Project: **4 to 8 weeks, minimum of three days per week, minimum of 45 minutes per day.**

Abstract:
This project involved students becoming aware of the difficulties of disposing of plastics. Students kept track of their own and their family's use of plastics. They contacted and shared information with environmentalists and waste disposal experts.

I. Introduction

Utilizing video, written resources, and telecommunication services provided by PBS Learning Link and CORE, this project examines what impact plastics consumption has on our environment. The ecological goal of this project is that students will educate their families to practice the 4 R's of waste management: Reduce, Reuse, Recycle and Reject.

If one looks up the word "educate" in a thesaurus, one sees the words "nurture and cultivate". Education uses the same terms one would find in discussing our environment. How do we relate to ourselves? How do we cultivate friendships? How do we manage our home, the Earth? Each generation is the caretaker and guardian of our planet for the next generation. As educators and parents, we are responsible for inculcating an environmental consciousness which respects and preserves our Earth and its precious resources.

Many students are unaware of the waste disposal problem in our country. They dispose of their trash. A truck comes along, collects it and takes it away. America has a mounting waste disposal problem; we are generating tons of garbage. Marketing and advertising have changed our buying habits. We use disposable razors, disposable diapers, disposable bottles, etc. In turn, this has conditioned us to use a product once and then get rid of it.

The activities in this project are aligned with the elements of the California Science Framework. They introduce students to the connections among the disciplines of physical, earth, and life sciences. The activities require that students be critical thinkers. The project utilizes community resources and offers students a look into environmental careers.

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bottle?

Use Of Plastics

How many pounds of plastic per year does the average American use?

What kinds of plastic items are recyclable?

What are some problems associated with bio-degradable plastics?

How many plastic lined disposable diapers are thrown away each year?

Disposal Of Plastics

How many pounds of plastic are dumped into the sea each year and what kinds of problems are caused by that dumping?
How many years will most plastics last when buried in a landfill?
How many tons of garbage do Americans generate per year?
What are some of the problems that waste management professionals face in regard to landfills?

What Is Plastic And How Is It Made?

What natural resources are used to make plastics?
When was plastic first developed?

Plastic In The Workplace

What percent of plastics are used for packaging?
What are some example of Low Density Polyethylene products (LDPE); examples of High Density Polyethylene products?
What are some of the uses of plastic in medicine?

Essays

After reading an article, using on-line and CD-ROM encyclopedias, and/or viewing a video, students write a short essay recording facts they have gathered and any suggested research answers they have discovered. Students also draw pictures related to this project in their journals.

Addendum

Household Disposal Data Collection Sheet

Directions:

During a five day period, record the type and number of plastic items normally placed in the garbage during this time period. Tape a copy of the Data Collection Sheet on a wall next to the waste container. During the survey period, ask all members of the household to become involved and request that they put a check mark on the line which best describes the item.

Optional: The original project requested that all plastic items be placed into a special container during the week of the survey. This practice involves rinsing out all plastic items and the need for other assurances against odors and pests. The plastic materials could be weighed for total volume and measured for amount of space usage.

Disposable diapers are plastic lined and included in the survey.

Beginning Date _____ Ending Date _____

Name_____ Number of People in Household_____

In the following statements, circle a letter which best describes your household.

1. In our household, we use paper bags instead of plastic when we shop.
   A. Frequently B. Sometimes C. Seldom D. Never

2. In our household, we make a conscious effort to recycle.
   A. Frequently B. Sometimes C. Seldom D. Never

3. In our household, we make an effort to choose products that use environmentally friendly packaging (no Styrofoam, no plastic) even should it cost more or be less convenient.
   A. Frequently B. Sometimes C. Seldom D. Never

	(plastic wrap)		
Resources for the Teacher	OTHER NUMBER OF ITEMS	_____ _____	_____ _____

Telecommunication Resources

LEARNING LINK

Select:
Curriculum Resources (R) / Science - Environment (F) /
The Problem with Plastics
Winning The War Against Garbage
Brochure on Environmental Cleanup
Resources - Do It, For Earth's Sake
ESPN Team Up to Clean Up Curriculum Guide

Select:
Discussion Center for Topics (D) / Look for Listing on Plastics Project

INTERNET RESOURCES - *Using CSUNet*

For conference newsgroups, follow the sequence below:

Electronic Services (A)/Computer Conferencing (C)
Type y (this yanks in other conferences)
Type h (this provides a help screen for using conferences
Scienvironment (a news group on environmental issues; students can read, write or reply to messages)

For an environmental service, follow the sequence below:

Electronic Services (A)/Outside Services (B)/Empire Schoolhouse (14)/Academic Wings (4)/Science and Space (4)/EcoGopher (4)/ EcoGopher Library (8)
Students use keywords (eg: plastics, polymers) for searching databases through this environmental service.

Other Internet Gateways

Using the Internet Gopher
The Gopher is a lookup tool that lets the user find Internet resources.

Collaborative Teamwork:

Developing Multimedia Programs Using On-Line Telecommunications

Jim Roller

Science and Technology Center
Apple Valley, CA

Subject Area(s): "Thematic" to include reading, math,science, language arts, social studies, art
Grade Level(s): **2-5** *(and upwards with adaptation by teacher)*
Length of Project: On going

Abstract:

Students used California State frameworks and on-line resources to access information in order to design lessons for special needs students. They learned to use Hyperstudio and a variety of other techniques to devise, communicate and access information for these projects.

I. Introduction

Have you taken a class in the last couple of years and found yourself working in a collaborative group, developing a project or product reflecting the concepts you are learning? All over the world, businesses and educators are realizing the power of cooperative groups and collaborative teamwork. How can we as teachers better facilitate our students in learning these powerful skills as well as the academic goals and objectives we are to teach?

In this project, students will work in collaborative groups, using multimedia to develop HyperStudio "Stacks" or programs. They will use information gathered from CD-ROM and on-line telecommunications sources such as America On Line, Scholastic Network, and CORE to develop their stacks. They will use telecommunications (primarily e-mail) for the purpose of sending their stacks to other children around the country.

Although this project is currently being field tested with Gifted and Talented Education (GATE) students that attend class for three and one half hours, once a week, three weeks a month, it could be implemented in a regular or special education class at any grade level. Student lessons are created on HyperStudio stacks for the use of other students. The subjects of the stacks vary but reflect the themes from the California State Framework. Students are currently using Laser disk information from the State adopted Scott Forseman Science Series "Discover the Wonder" as well as math and language arts from State adopted series.

Bringing telecommunications into the classroom opens the door to a new way of teaching and learning for teachers as well as students. There is power in knowing how to access information and working with a partner or collaborative group to develop a project. Using telecommunications as a tool for communication, research and inquiry becomes an exciting and valuable means by which one can develop alternative methods for learning. Students and teachers experience new ways to communicate, removing them from the isolation of the traditional classroom, thus creating a new atmosphere of excitement in education.

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1. What Is Multimedia? *(three week activity)*

Students will learn to use HyperStudio, a multimedia program, and begin to publish their own "stacks" using original art, clip art graphics, original and disk library sounds, partial and full animation. Students will work in pairs and follow a preformatted sequenced plan of activities.

2. Tele-What?! *(five day integrated, thematic activity)*

Teacher will lead class discussion on basic human cultures developing distance communication technologies prior to the electronic era (drums, fire, smoke signals, mirrors, flags, etc.).

Students will be divided into teams (three to four each). Each team will develop a communication technology capable of sending understandable messages across the playground at a distance of approximately 200 yards. They must send several different kinds of messages. Students need to consider speed, accuracy, noise, and efficiency. After testing their system, students will assess the efficiency and success of their system. They will discuss with other teams in the class how they developed their ideas and how they would modify and improve their system. Students will compare and contrast their telecommunications system with today's technology. Each team will develop a HyperStudio stack or card representing the results of their findings.

3. What Is E-Mail? *(one day lesson)*

Students will learn the basics of electronic mail, how information is transferred over phone lines, how information is changed from digital to analog and back to digital, and how computers are used to send and retrieve information over distances.

4. SnailL-Mail Vs. E-Mail *(three-day in-class activity—over approximately one and one half weeks)*

Begin with a class discussion of definitions of snail-mail and e-mail. (Snail-mail may be defined as traditional letters sent through the postal system.) E-

IV. Assessment

In assessing a thematic project, one needs to be aware of growth in a variety ofareas. How students worked in cooperative learning groups, how their enthusiasm for the curricular areas was enhanced through the use to technology, whether other teachers and parents became more aware of improved learning through lesson strategies, are side benefits, not necessarily formally evaluated but noted as observable outcomes.

Stated student outcomes will be assessed using the following methods: Students' progress in multimedia will be assessed using electronic portfolios (folders on the Mac platform) reflecting the successful development of HyperStudio stacks. Multimedia projects will also reflect understanding of academic subject areas. The use of telecommunications through on-line activity, reflecting students' use of e-mail accounts, data acquisition, etc., will be monitored by the systems operator and assessed by the teacher. Projects will also reflect "current" information procured through telecommunications as well as information learned from textbooks.

AV irtual Treasure Hunt In Spanish-Speaking Countries***

A Collaborative Project between a High School Spanish Language Class and a Second Grade Monolingual Spanish class

Diane Berthoin-Hernandez

North Monterey County High School
Castroville, CA

Subject Area:
Spanish III
Grade Level:
High School
Length:
One semester

Abstract:
Third year Spanish students "adopted" students in a Spanish speaking elementary school classroom. They researched and telecommunicated information about a Spanish speaking country to the students in Spanish. They presented the information to the elementary students in the form of a treasure hunt.

I. Introduction

Education in the United States has taken on an important change. We have recognized that students must become responsible learners in order to produce responsible citizens. We recognize that we must allow students to be critical thinkers and planners while still in school. Finally, we recognize the fact that depth and personalization of knowledge is imperative.

This movement in education does not exclude the second language classroom. We have a special responsibility in the second language classroom not only to prepare our students to be critical thinkers, but to use a new language to make new connections in the world.

It is exciting to think of language teaching curriculum with the new tools that computers bring to classrooms. The possibilities for creating lessons in which our students can become critical thinkers, planners, and language users now are boundary-less. The realm of Spanish speakers throughout the world is within the reach of each student who has access to telecommunications.

This project will produce two outcomes—a treasure hunt specifically designed for second grade Spanish speaking students and a Hypercard/Hyperstudio stack to demonstrate knowledge of one Spanish speaking country. The treasure hunt involves the following: The high school students form into ten groups to represent ten different Spanish speaking countries. They develop a list of topics they believe will create a pool of information which represents the culture of their chosen country. They collect the necessary data from several sources—library, CD ROM, laser disc, on-line sources and native citizens of the countries. The high school students organize and send the information in the form of clues via E-mail to the second graders who are not given the name of the country thus creating a treasure hunt for the students.

The Hyperstudio stack is produced by the high school student to demonstrate his/her knowledge of the country studied.

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their questions with class. All questions are included in the Class Portfolio.

Activity 4. So What is Culture?

a. Individually students brainstorm the meaning of culture. Ideas are shared with cooperative group. All ideas are recorded in the class portfolio.

b. Students write a two page essay about what culture is and share with group.

c: Each student brings one item from home which represents a symbol of his/her family's culture. Each shares the item and its significance to the class.

d: Create a square for the Culture Quilt. Each student receives a small paper square, glue, and scraps of paper. Using the paper, a quilt square is created which represents a cultural image of the family.

Activity 5: Collaborative Classwork

Committees are appointed to do the following:

1. put the Culture Quilt together.
2. write an introductory letter to the second grade children
3. develop a list of clue items to send to the children as they are sent out on the treasure hunt of their countries.
4. develop timeline for the project. (include research completion dates and e-mail dates)

Activity 6: Journals

Reflective Journal: After each day of the planning stage, either as a homework assignment or as an end of class activity, students write in their reflective journals about the planning stage of the project. The primary questions to answer are: What did I learn today? How did I learn this? What questions or doubts do I still have? Journals can be shared with group or whole class.

Activity 7: What is Hypercard?

After an introductory lesson on the purpose and workings of Hypercard, students choose a topic to develop a storyline for a Hypercard stack.

A physical stack of index cards is brought into class. Topics such as: How to get a pig ready for the fair, Fencing, Ballet, Basketball and My family traditions are used to create simulations which illustrate how Hypercard works. Students create Hypercard stacks. Assessment of the Hyper cards by peer evaluation.

Using the information gleaned from the research completed for the second grade students, students will create a Hyper card stack with a specific audience in mind—either another high school student/adult or a second grade child. A rationale for the style and content of the Hypercard stack is be included on an Introduction card at the beginning of the stack. Students include a source card in which all resources are cited.

Activity 11: Oral presentation of the project.

Each group presents the information about the country studied. Hypercard stacks can be used in conjunction with other multimedia to support and enhance the presentations.

Activity 12: Hypercard Stacks On-line

Hypercard stacks are shared on-line with the audiences for which they were intended, i.e. stacks for adults will be shared with adults, those designed for second graders will be sent to second graders.

V. Assessment

Self evaluations and peer evaluations will be an on-going part of all activities. Class meetings will be held using specific questions about the progress made with the research. Essays, Hypercard stacks, correspondence, and clues will be examined for the effective use of Spanish, understanding of culture, evidence of communication skills, use of on-line research, and collaboration. Portfolios will be started using these artifacts.

Rationale for having partners in the second grade:

When an actor has an audience to perform for his performance resonates and shines. A quiet,.dull, bored audience or no audience at all does little to improve his acting. The applause and the anticipation of his audience encourages him to do a better job at every moment. And thus we can say the same for Spanish students who so often have only a teacher to "perform" for. By establishing a strong connection with small children, the high schoolers will feel a need to perform well and provide for the best entertainment and information for their little adoptees. They are working with children who count on them to do a good job.

(In our particular situation no other on-line resources could be used except for in individual cases since NO INTERNET connection on a local level is possible. The AOL connection proved to be adequate and user friendly for students who had NO experience with on-line information and for the major-

Appendix D: Participants in FWL Survey of Staff Development and Technology

Participants in FWL Survey of Staff Development and Technology

Survey Participants:

Jan Meizel, Davis Joint Unified School District

Bill Wright, Consortium for School Networking

Lauri Maak, Telecommunications Consultant

Andy Dunau, Dunau and Associates

Allen November, Telecommunications Consultant

David Thornburg, Thornburg Center for Professional Development

John Vaille, Computer-Using Educators

Cyndy-Everest Bouch, Christa McAuliffe Fellow and International Society for Technology in Education Board Member

David Foster, Southwest Educational Development Laboratory

Bev Hamilton, California Software and Video Clearinghoues

Kathleen Fulton, U.S. Congress Office of Technology Assessment

Connie Stout, Texas Education Network

Kam Matray, Monterey Model Technology Schools Project

Carol Gilkinson, Charter Oak Unified School District, Christa McAuliffe Teacher of the Year

Chris Dede, Center for Interactive Educational Technology, George Mason University

Frank Withrow, Council of Chief State School Officers

Gwen Solomon, U.S. Department of Education Office of Educational Technology

Al Rodgers, Global School Net

Appendix E: World Wide Web Hotlist for Educators

Education Resources on the Internet:

An Introductory Guide to Select Internet Education and Related Resources

The University of the State of New York • The State Education Department

August 1995

CONTENTS

INTRODUCTION v

EDUCATION 1

GOVERNMENT 26

MISCELLANEOUS 32

INDEX 38

GLOSSARY 41

Name	Internet Address	Description
Academy for Educational Development (The)	gopher://aed.org:70/1	The Academy is an independent, nonprofit service organization committed to addressing human development needs. This gopher site includes Mission and Organization; press releases; publications; Democracy Development Services; disabilities and special education services; environmental education; gender equity services; health population and nutrition services; instructional technology services; international exchange and training services fellowship; policy development and information services; preschool, primary, secondary, higher and adult education; work force and economic development; youth development; and related Internet resources.
Academic Position Network	gopher://wcni.cis.umn.edu:111111	An online service providing notice of academic position announcements, including faculty, staff and administrative positions.
Access Excellence Network	http://www.gene.com/ae	This is a national educational program that puts high school biology teachers in touch with their colleagues, scientists and critical sources of new scientific information through the Internet. The site includes Activities Exchange; About Biotech; What's New; Resource Center; Teacher-Scientist Network; The Teacher's Lounge; and Make the Connection.
Alternative Colleges Network	http://hampshire.edu/html/cs/alt-colleges/HOME.html	A resource for students interested in exploring alternative institutions of higher learning and exchanging ideas and experiences connected with progressive education.
American Association for Higher Education, Teaching, Learning and Technology Roundtable	http://www.ido.gmu.edu/aahe	Seeks to improve the quality and accessibility of higher education through the selective use of information technology and information resources in teaching and learning -- while controlling costs.
American Association for the Advancement of Science Project	gopher://gopher.aaas.org:70/11/.activities/.2061	The Project is a long-term initiative to reform K-12 education nationwide so that all high school graduates are science literate. This site comprises Update 94 (including the history, current efforts and accomplishments of Project 2061); newsletters; and information about relevant workshops, and how to order documents and software.

Name	Internet Address	Description
American Association of Collegiate Registrars and Admission Officers	gopher://aacrao-dec.nche.edu:70/00GOPHER-ROOT%3a%5b000000%5d-AB	The Association is committed to providing easily accessible information resources to registrars, admission officers, and other higher education professionals around the world. At this site you will find information on the various activities of AACRAO's national office, board of directors, committees, and projects.
American Council on Education (ACE)	gopher://Bobcat-ACE.NCHE.EDU:70/1	This gopher site comprises the ACE Bookstore; staff phone book; the Alliance to Save Student Aid; Federal Register; ACE departments; library and information service; MINITEX Veronica searchers; One Third of the Nation Conference; The Chronicle of Higher Education; The Electronic Newsstand; University of Maryland; and other information about the gopher.
American Educational Research Association (AERA)	http://www.asu.edu/aff/aera/home.html	AERA is concerned with improving the educational process by encouraging scholarly inquiry related to education, and by promoting the dissemination and practical application of research results. This website is designed to provide information about the organization and serve as a resource for the membership. It includes specific information about the 11 AERA divisions; and additional information and resources (i.e., publications, resources, annual meeting).
American Library Association (ALA)	http://www.ala.org/	The American Library Association (ALA) is the oldest and largest library association in the world. The Association is the chief advocate for the people of the United States to achieve and maintain high-quality library and information services. This site, while still under construction, provides information about the activities of ALA, the 11 divisions, chapters and affiliates.
Annenberg/CPB Higher Education Project	http://www.cpb.org/annenberg/annenberg.html	The Annenberg Project supports programs that use telecommunications to improve the quality and accessibility of higher education.
Apple Computer Higher Education: The Apple Virtual Campus	http://www.info.apple.com/hed	The Apple Virtual Campus links people with shared resources. It empowers the student, the professor, and the administrator, while creating new communities for interactive learning and collaboration. The strategic components of the Campus include Learning Technologies, Distance Learning, Collaboration, Information Access, Workflow, and Mobility.

Name	Internet Address	Description
Apple Education	http://www.info.apple.com/education	Apple Education serves preschools through high schools located in the United States. This site includes information from product design and education research to curriculum solutions and teacher training tools. The site provides access to Apple Classrooms of Tomorrow (ACOT), and Effectiveness Reports (reports on most current research findings about the effectiveness of technology in education).
Arizona Board of Regents	http://www.asu.edu/arizona/azbor/homepage.html	Describes the responsibilities of the Arizona Board of Regents, and provides information on current members (under construction).
Ask ERIC Virtual Library	http://ericir.syr.edu	The Virtual Library includes such components as Lesson Plans; Ask ERIC's Collections; Search ERIC Database; Search Ask ERIC's Gopher; ERIC Clearinghouse & Components; the Discovery Learning Community; CIVNET (civic education); Newton's Apple (PBS science series); and Ask ERIC Toolbox.
Association for Educational Communications and Technology	gopher://sunbird.usd.edu:72/00	The Gopher database is a project of the Association for Educational Communications and Technology (AECT), an international, professional organization dedicated to the improvement of instruction through the utilization of media and technology.
Association for Supervision and Curriculum Development (ASCD)	http://www.ascd.org	This site includes ASCD Information; What's New on ASCD Web; ASCD Resources; and Educational Resources on the Internet.
Association of Research Libraries (ARL)	gopher://arl/cni.org/	The purpose of the Association is to identify and influence forces affecting the future of research libraries in the process of scholarly communication. ARL programs and services promote equitable access to, and effective use of recorded knowledge in support of teaching, research, scholarship, and community service. This site comprises ARL member libraries; ARL Gopher; ARL Electronic Atlas; information policy; scholarly communication; collection development; ARL statistics and measurement; and ARL publications.
Brookings Institution	gopher://gopher.brook.edu:70/1	A private nonprofit organization devoted to research, education, and publications in economics, government, foreign policy, and the social sciences generally. This gopher site is still under construction but already includes Brookings publications; other gopher and information servers; and a list of Internet file server (FTP) sites.

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Name	Internet Address	Description
California Department of Education	gopher://goldmine.cde.ca.gov:70/11	This site provides information on the California Department of Education (i.e., 1995 Calendar, advisory groups, child development, curriculum, demographics, 1994 dropout rates, finances, grants, libraries, publications, restructuring, special education, technology, and State Board highlights); the California Code; School Districts; Goldmine Usage Statistics; CLAS scores for all counties; and other information servers.
Carnegie Corporation	gopher://tiger.jvnc.net:3000/11/Carnegie_Corporation_of_New_York	A grant-making educational foundation that also sponsors commissions dealing with specific topics. This gopher site includes general information; the Corporation's Program; how to submit a proposal; grant restrictions; contacting Carnegie Corporation; Andrew Carnegie and his philanthropies; other Carnegie organizations; trustees and administration; Carnegie commissions and task forces; and recent publications.
CAUSE, Association for Managing and Using Information Resources in Higher Education	http://cause-www.colorado.edu	CAUSE works to enhance the administration and delivery of higher education through the effective management and use of information. It includes the information resources library; institutions' database; and CAUSE publications.
Center for Educational Leadership, McGill University	http://www.cel.mcgill.ca/welcome	A university-based unit which promotes the continuing professional development of teachers, policymakers and educational leaders by providing them with state-of-the-art programs of learning, service, and research.
Center for Excellence in Education (CEE)	http://rsi.cee.org	The purpose of the Center is to help students and teachers keep the U.S. competitive in science and technology, and to nurture international understanding among potential leaders of many countries. The site includes the history of the Center, and information on the research science institute.
Center for Labor Research and Education (CLRE)	gopher://violet.berkeley.edu:2521/1	The Center produces educational programs, publications, research and materials on issues that are relevant to organized labor and the work force. Ongoing projects include an internship program for students in their senior year; the Labor Center Reporter, which is a graduate student publication; an annual conference on labor-management cooperation in the public schools; training programs for unions on the use of computers in communication and research; and course development and teaching in the Summer Institute for Union Women.

Name	Internet Address	Description
Center for Research in Educational Policy (CREP)	http://www.coe.memphis.edu/coe/CREP/crep2.html	The Center's mission is to implement a research agenda associated with educational policies and practices in the preK-12 public schools of Tennessee and the nation, and to provide a knowledge base for use by educational practitioners and policymakers. This site provides access to the CREP newsletters and publications, and information about CREP projects.
Center for Research on Educational Accountability and Teacher Evaluation (CREATE)	gopher://gopher.wmich.edu:70/1wmu/evalcntr/CREATE	CREATE's Federal mandate calls for it to be the focal point for U.S. efforts to improve measurement criteria, instruments, and procedures for evaluating the performance of teachers, administrators, support personnel, and programs in both public and private schools, as well as for evaluating the schools themselves.
Center for Talent Development (The)	gopher://ctdnet.acns.nwu.edu	The Center's mission is to provide specialized support and services to academically gifted and talented youth. The site includes CDTNET information; current events; reference materials; surfing the net, contests and competitions; the Philosophers Forum; and the Talent Development Magazine.
Center for Teaching and Learning, (The) Duke University	http://www.ctl.duke.edu:80/	The Center provides opportunities for serious discussion and to disseminate information about issues regarding teaching. The site includes offerings, services and activities of the Center; other electronic resources dealing with teaching and learning issues; examples of innovative approaches to technology and education; some multimedia resources; information about World-Wide-Web and Browsers; some Internet tools; some collections of online books and publications; and Sundry Information and Services.
Center for Telecommunications Research, Columbia University	http://www.ctr.columbia.edu	Includes the CTR Research Groups and CTR Information. Users need NETSCAPE 1.0N software or a later version to access this site.
Center for Women's Studies in Education	gopher://gopher.porpoise.oise.on.ca:70/11/resources/CWSE	The Center promotes, conducts and disseminates research in women's studies. This site includes Sustaining Projects (long-term); Research Projects (short-term); and other resources, including information on other women centers on the information superhighway.

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Name	Internet Address	Description
Chicano/Latino Network	gopher://latino.sscnet.ucla.edu:70	Chicano/Latino Net is an electronic mechanism which brings together Chicano/Latino research as well as linguistic minority and educational research efforts being carried out at the University of California and elsewhere. It serves as a gateway among faculty, staff and students who are engaged in research and curricular efforts in these areas. This site comprises such resources as directories (Chicana-Latina Directory, Chicano-Latino Organizations, and Research Organizations and Associations), centers (community, employment, conference, research, statistical, classroom, and student center); Internet searching tools; and other gopher servers.
Children Now	http://www.dnai.com/~children	This gopher site is developed to help address issues affecting children. It includes membership information; Action Alert (a contract to be signed to show concern for children and to take a personal pledge of accountability to children); Learn More About Children's Issues (i.e., improving schools, violence, media, health, and family economic security); Take Action for Our Nation's Children; other online resources on children's issues (i.e., education, children safety, children's health, online sources for statistics on the status of our Nation's children, parenting resources, general resources, children around the world); and volunteer centers and listings online.
Children, Youth and Family Education Network (CYFERNet)	gopher://ra.esusda.gov:70/1	An electronic Internet-based children, youth and family information system operated by the Cooperative Extension System and the National Agricultural Library. It provides access to programs, and information and research from four networks (National Network for Family Resiliency, National Network for Collaboration, National Network for Science and Technology, and the National Network for Child Care).
Chreods	http://s13a.math.aca.mmu.ac.uk/	An electronic journal exploring educational issues with a math education tendency.
Chronicle of Higher Education (The), Academe this Week	http://chronicle.merit.edu	A complementary service of The Chronicle of Higher Education. A new edition is available on the Internet beginning every Tuesday at noon, Eastern time. Includes summaries of articles published in the latest Chronicle.

Name	Internet Address	Description
Cleveland State University Law Library	gopher://gopher.law.csuohio.edu	The site includes electronic information; FTP services; legal sources on the Net; local WAIS sources; nonlegal related Internet services; OhioLINK and other library resources and information servers; search different databases; and USENET services from Cleveland State University.
Clonlara School	http://web.grfn.org/education/clonlara	Clonlara defines itself as the first high school over the Internet in October 1994. The website provides information about the school's offerings, including information about a program for individuals 20+ who have no high school diploma.
Coalition for Networked Information (CNI)	gopher://gopher.cni.org:70/1	Promotes the creation of, and access to, information resources in networked environments to enrich scholarship and to enhance intellectual productivity.
College Board (The)	http://hub.terc.edu/ra/collegeboard.html	The Board promotes universal access to high standards of learning, equity of opportunity, and sufficient financial support so that every student is prepared for success in college and work. This site includes the Equity 2000 News program.
Colorado K-12 Internet Gopher Server	gopher://k12.colostate.edu	The gopher site includes Adventures in Supercomputing Sites; connecting with other computers via Telnet; the Internet K-12 Curriculum Repository; other information services; and pictures.
Computer as Learning Partner	http://www.clp.berkeley.edu/CLP.html	An ongoing educational research effort at the University of California at Berkeley dedicated to informing and improving middle school science instruction.
Condition of Education, 1994 (The)	gopher://gopher.ed.gov:10000/11/publications/majorpub/condition/1994	This site provides a copy of the Condition of Education, and allows the user to access discreet chapters of the document separately.
Conservation Online, Resources for Conservation Professionals (CoOL)	http://palimpsest.stanford.edu/	CoOL, a project of the Preservation Department of Stanford University Libraries, is a full text database of conservation information. The databases cover a wide spectrum of topics of interest to those involved with the conservation of library, archives, and museum materials. This site includes relevant documents; mailing list archives; European Confederation of Conservator-Restorer's Organizations; International Council of Museums; guides to resources; and other tools and resources.

Name	Internet Address	Description
COOMBSQUEST, Australian National University	gopher://coombs.anu.edu.au	The site provides access to information from the Social Science Research Data Bank, including guides and query systems; leading information facilities; electronic journals; Coombsquest networked facilities; and Coombsquest special projects.
Council for the Advancement and Support of Education (The) -- CASE	gopher://gopher.case.org:70/11/abotcase	A nonprofit education association offering training conferences, publications, and many other services to aid members in doing their jobs better in institutional advancement.
CRESST (National Center for Research on Evaluation Standards and Student Testing)	http://www.cse.ucla.edu/CRESSTHOME.html	The purpose of CRESST is to supply educational research and information leading to productive assessment reform in American schools. This site includes CRESST Line; Evaluation Comment; Technical Reports; Portfolio Assessment and High Technology; and the Alternative Assessment Databases.
CUNY, Information Resource and Online Academic Degree System	http://www.cityu.edu	Provides information about the City University of New York (CUNY), and is a vehicle for students to complete select courses via the Internet.
DeweyWeb, University of Michigan	http://ics.soe.umich.edu	An experiment in global education. The DeweyWeb appears to be evolving into a clearinghouse for experiments in electronic experiential education (or telecommunications-based education).
Digest of Education Statistics, 1994	gopher://gopher.ed.gov:10000/11/publications/majorpub/digest94	This site provides a copy of the Digest, allowing the user to access discreet chapters of the document separately.
Directory of WWW.*.EDU Servers	http://www.zurich.ibm.com/wwwedudirectory.html	This site lists all www.*.eduservers defined (July 1995).
Distance Learning Directory	http://www.mitn.msu.edu:80/distance.htm	This site comprises K-12 education resources; satellite broadcast resources; desktop video tools; technology news and information; and related directories.
Education Alliance for Equity and Excellence (The)	http://www.brown.edu/Research/The_Education_Alliance	Believing that language, culture, and diversity are fundamental to the success of educational reform, the Alliance creates partnerships with educators, policymakers, researchers, and business and community agencies. This site includes the Multifunctional Resource Center; the New England Desegregation Assistance Center; the Superintendent Leadership Council; and a short directory of educational resources.

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Name	Internet Address	Description
Education Policy Analysis Archives (The)	http://info.asu.edu/asu-cwis/epaa/welcome.html	A peer-reviewed scholarly journal published entirely electronically. Articles deal with education policy at all levels and in all nations.
Educational Forum	gopher://info.asu.edu:70/11/asu-cwis/education/journals/edforum	This site provides information on how to subscribe to Education Forum, as well as table of contents for several volumes, and the full text of selected articles from the Forum.
Educational Services	http://www.cix.org:80/pointers/education.html	This site includes the Virtual Library of Educational Resources; C++ Tutorial Textbook (a virtual course from the Globewide Network Academy); English server; Expo (a virtual museum); Project GeoSim (geography education software); Hillside Elementary School; Hypertext Webster Interface; the Interpedia (online encyclopedia); The Journey North (an exhibit concerning the Artic and wildlife migration); the Museum of Paleontology (exhibits of fossils of dinosaurs, mammals and other animals); and miscellaneous education related links.
Educational Testing Service (ETS)	http://hub.terc.edu/ra/ets.html	The Educational Testing Service is the world's largest private education measurement institution. Information on upcoming test dates is provided on this site.
EDUCOM	http://www.educom.edu	EDUCOM offers leadership and assistance to member institutions in order to address the critical issues surrounding the role of information technology in higher education. This site includes EDUCOM Review; EDUPAGE; and EDUCOM Update.
E-MATH	gopher://gopher.cic.net:3005/00/telnetsites/e-math	E-MATH is maintained by the American Mathematical Society (AMS). It is primarily for math educators and professionals, and provides online access to employment opportunities, software, and a variety of math publications.
Empire Internet Schoolhouse	gopher://nysernet.org:3000/11	The Schoolhouse provides teachers and students navigating the Internet resources for the classrooms.
Environmental Education Network (EEN)	http://www.envirolink.org/enviroed	A collaborative effort to bring environmental education online and into a multimedia format. The EEN acts as a clearinghouse for all environmental education information, materials and ideas on the Internet. This site comprises environmentally-related resources for students and teachers.

Name	Internet Address	Description
ERIC Clearinghouse for Community Colleges	gopher://ericir.syr.edu:70/11/Clearinghouses/16houses/CCC	The Clearinghouse focuses on the development, administration, and evaluation of two-year public and private community and junior colleges, technical institutes, and two-year branch campuses. It provides a linkage between two-year colleges and business/industrial/community organizations, and a mechanism for the articulation of two-year colleges with secondary and four-year postsecondary institutions.
ERIC Clearinghouse for Science, Mathematics, and Environmental Education	gopher://gopher.ericse.ohio-state.edu:70/1	The Clearinghouse has as its primary function the retrieval and dissemination of printed materials related to science, mathematics, and environmental education. This information is indexed and abstracted for inclusion in two monthly publications, "Resources in Education" (RIE) and "Current Index to Journal in Education" (CIJE).
ERIC Clearinghouse on Adult, Career and Vocational Education	gopher://ericir.syr.edu:70/11/Clearinghouses/16houses/CHE	This site comprises ERIC Digests; ERIC Keys; Myths and Realities; Trends and Issues Alerts; and the Practitioner File.
ERIC Clearinghouse on Assessment and Evaluation, The Catholic University of America	http://www.cua.edu/www/eric_ae	The Clearinghouse provides balanced information concerning educational assessment and resources to encourage responsible test use.
ERIC Clearinghouse on Counseling and Student Services	gopher://ericir.syr.edu:70/11/Clearinghouses/16houses/CCSS	The Clearinghouse focuses on the preparation, practice, and supervision of counselors at all educational levels and settings, as well as the theoretical development of counseling and guidance, including the nature of relevant human characteristics. It also reviews the use and results of personnel practices and procedures, and group process (counseling, therapy, dynamics) and case work.
ERIC Clearinghouse on Disabilities and Gifted Education	gopher://ericir.syr.edu:70/11/Clearinghouses/16houses/ERIC_GE	The Clearinghouse focuses on all aspects of the education and development of persons (of all ages) who have disabilities or who are gifted, including the delivery of all types of education-related services to these groups. It also includes prevention, identification and assessment, intervention, and enrichment for these groups, in both regular and special education settings.
ERIC Clearinghouse on Educational Management	gopher://ericir.syr.edu:70/11/Clearinghouses/16houses/CEM	The Clearinghouse looks into all aspects of the governance, leadership, and structure of public and private educational organizations at the elementary and secondary levels, including the provisions of physical facilities for their operation.

Name	Internet Address	Description
ERIC Clearinghouse on Elementary and Early Childhood Education	http://ericps.ed.uiuc.edu/ericeece.html	The Clearinghouse is responsible for collecting and disseminating information on parenting, child development, child care, and aspects of early, elementary, and middle level education not covered by other ERIC clearinghouses. ERIC/EECE offers a question-answering service, ERIC searches, and publications.
ERIC Clearinghouse on Higher Education	gopher://ericir.syr.edu:70/11/Clearinghouses/16houses/CHE	The Clearinghouse concentrates on all aspects of the conditions, programs, and problems at colleges and universities providing higher education (i.e., four-year degrees and beyond). This includes: governance and management; planning; finance; interinstitutional arrangements; business or industry programs leading to a degree; institutional research at the college/university level; Federal programs; legal issues and legislation; professional education (e.g., medicine, law, etc.), and professional continuing education.
ERIC Clearinghouse on Information and Technology	gopher://ericir.syr.eu:70/11/Clearinghouses/16houses/CIT	The Clearinghouse focuses on educational technology and library/information science at all academic levels and with all populations, including the preparation of professionals. It looks at the media and devices of educational communication, as they pertain to teaching and learning (in both conventional and distance education settings); the operation and management of libraries and information services; and all aspects of information management and information technology related to education.
ERIC Clearinghouse on Languages and Linguistics	gopher://ericir.syr.edu:70/11/Clearinghouses/16houses/CLL	The Clearinghouse focuses on languages and language sciences; all aspects of language instruction and learning in all commonly and uncommonly taught languages, including English as a second language; bilingualism and bilingual education; cultural education in the context of second language learning, including intercultural communication, study abroad, and international education exchange; and all areas of linguistics, sociolinguistics, and psycholinguistics.

Name	Internet Address	Description
ERIC Clearinghouse on Reading, English and Communication Skills	gopher://gopher.indiana.edu:1067/11/eric_rec	The gopher provides information about the specific services that this Clearinghouse offers to parents, educators, and others interested in the areas of reading, English, and communication; general information about the ERIC system as a whole; "pointers" to other sources of educational information when appropriate; lists and descriptions of the publications available from the Clearinghouse; information about family involvement workshops; and teaching ideas for journalism educators.
ERIC Clearinghouse on Rural Education and Small Schools, Appalachia Educational Laboratory, Inc.	gopher://ericir.syr.edu:70/11/Clearinghouses/16houses/CRESS	This site provides bibliographies; full-text publications; a publication list; and Directories (Native Education, Rural Education, and Outdoor Education).
ERIC Clearinghouse on Social Studies and Social Science Education	gopher://ericir.syr.edu:70/11/Clearinghouses/16houses/CHESS	The Clearinghouse monitors issues about the teaching and learning of history, geography, civics, economics, and political science, as typically taught in the K-12 curriculum, and covers other topics such as law-related education, art education, and music education.
ERIC Clearinghouse on Teaching and Teacher Education	gopher://ericir.syr.edu:70/11/Clearinghouses/16houses/ERIC_SP	The Clearinghouse focuses on school personnel at all levels; teacher recruitment, selection, licensing, certification, training, preservice and in-service preparation, evaluation, retention, and retirement; the theory, philosophy, and practice of teaching; the organization, administration, finance, and legal issues relating to teacher education programs and institutions; and all aspects of health, physical, recreational, and dance education.
ERIC Clearinghouse on Urban Education	gopher://ericir.syr.edu:70/00/Clearinghouses/16houses/CUE	The Clearinghouse concentrates on the educational characteristics and experiences of the diverse racial, ethnic, social class, and linguistic populations in urban (and suburban) schools; curriculum and instruction of students from these populations and the organization of their schools; the relationship of urban schools to their communities; and the social and economic conditions that affect the education of urban populations, with particular attention to factors that place urban students at risk educationally, and ways that public and private sector policies can improve these conditions.
Financial Aid Information	http://www.cs.cmu.edu/afs/cs/user/mkant/Public/FinAid/finaid.html	Provides links to sources of information about student financial aid.

Name	Internet Address	Description
Foundation for Continuing Education	http://www.usa1.com/nation/fce	A nonprofit educational resource and publisher offering seminars, books and manuals.
Franklin Institute Science Museum (The)	http://sln.fi.edu	This site brings exhibits, resources and fun of a museum visit right to the user's desktop. It includes virtual exhibits; educational hotlists; virtual exhibits hotlist; publications library; units of study to support science curriculum; samples of science programs and demonstrations; and exhibit summaries.
FrcdNet MOO	gopher://gopher.cic.net:3005/11/telnet-sites/frednet-moo	This is a new multi-user simulated environment dedicated to educational and social use. It will host online classes, meetings, school/K12 projects, lectures, parties, presentations of all kinds, and business offices.
GENSCOPE	http://copernicus.bbn.com:70/genscope/home.html	This website is a part of a project, sponsored by the National Science Foundation, that is developing educational software for teaching biology. It assists the users locate resources related to biology, including examples of software, images, and other medical and biological WWW servers.
George Lucas Education Foundation (The) -- GLEF	http://glef.org	The purpose of the Foundation is to facilitate innovative uses of multimedia technologies to enhance teaching and learning. This site includes information about the mission of the Foundation; current and past issues of Edutopia, the Foundation's newsletter; and information on how to reach the Foundation.
Harvard Graduate School of Education (HGSE)	http://gseweb.harvard.edu	To enhance the teaching and learning of children and adults, aid the instructional, research and administrative activities of the school, and to foster communication within the HGSE and with the greater electronic community around the world.
Higher Education Coordinating Board, Minnesota	gopher://gopher.hecb.state.mn.us	The Board is a state agency providing leadership in meeting higher education needs. This gopher site includes information about the Higher Education Coordinating Board; the Minnesota Statute 136A; Board membership, goals, agenda, and minutes; financial aid information; student enrollment data; State Postsecondary Review Entity; Higher Education Telecommunications Council; Library Planning Task Force; and other gopher and information servers.

Name	Internet Address	Description
Higher Education Center for Alcohol and Other Drug Prevention	gopher://gopher.igc.apc.org:7006/1	This gophersite aims to provide information and materials developed by the Higher Education Center and other alcohol and other drug (AOD) prevention efforts in higher education. It includes information on how to obtain assistance from the Center; Center publications and training workshops; searching the Higher Education Center's databases; calendar of events; drug-free schools and campuses information; and other online AOD resources.
IBM ACTS Higher Education Information Server	http://ike.engr.washington.edu	IKE is a higher education information service managed by the University of Washington in partnership with IBM. This site comprises IBM higher education news; promos, and partnerships; higher education software (software for downloading, the IBM Higher Education Software Consortium, and higher education software reviews and descriptions); general higher education information, publications and IBM Usenet archives; and links to related servers.
Illinois State Board of Education	http://www.isbe.state.il.us/homepage.html	Information provided by the Board of Education (i.e., Mission, K-12 Resources, ISBE Resources, and State Networks).
Indiana Department of Education, IDEANET	gopher://ideanet.doe.state.in.us	Contains education data from Indiana's 294 school districts and general purpose Bulletin Board services. In addition, IDEANET serves as a distribution medium for a variety of curricular materials.
Indiana Education Policy Center	http://www.indiana.edu:80/~iepc/	The Center provides nonpartisan research, information, and communication on education issues to Indiana policymakers and educators to improve education in the state. This site provides access to newsletters and briefs, and other Center publications; to the Indiana University Bloomington Home Page; and to a list of education resources.
Information for Teachers	http://www.eletriciti.com/~riakin	Internet resource for all teachers. INFO List is set up to gather information from the many Internet publications that contain valuable information for teachers.

Name	Internet Address	Description
INSPIRE	gopher://inspire.ospi.wednet.edu:70/1	Provided as a service of the Washington State's Office of the Superintendent of Public Instruction to assist K-12 education in locating useful resources on the Internet. It includes curriculum materials and resources; district and state technology plans; educational reform and improvement; the Educational Technology Support Center Program; grant funding for education; online curriculum projects; the OSPI Administrative Bulletin Board; and publications, a directory, and instructional support materials.
Instant Access Treasure Chest, (The), The Guide to Learning Disabilities and Foreign Language Learning	http://www.fln.vcu.edu/ld/ld.html	The site includes general information; assistive technology; Attention Deficit Disorder; Attention Deficit Hyperactivity Disorder; dyslexia; foreign language and LD; college policies for students with disabilities; teaching students with disabilities; questions and answers; learning styles; auditory deficits; visual deficits; and general information on disabilities.
International Association for Statistics Education (IASE) Archive	gopher://jse.stat.ncsu.edu:70/11/iase	This is an archive of information, software, and discussions related to statistics and statistics education. It contains the names and addresses of IASE members; updated information on publications and meetings; an IASE membership application form; and more.
Institute for the Academic Advancement of Youth (The)	gopher://juniverse.hcf.jhu.edu:10005/00/.gifted/.director/.reorg	The Institute shall have as its overall mission the advancement of learning for those students, educators, parents, and policymakers for whom high academic expectations and standards are a defining principle of learning. The Institute shall have a distinctive research agenda which focuses on talent development and learning, shall maintain and advance the Study of Exceptional Talent (SET), maximize the newest technologies for advancing individual learning and establish complex learning environments, and eventually establish a Diagnostic and Counseling Service that directs itself to issues of high ability as well as associated learning disabilities.
Instructional Technology and Training	http://www.yahoo.com/Education/Instructional_Technology_and_Training	Comprises a variety of sources on instructional technology and training, including journals.
Instructional Technology Research Online (INTRO)	http://129.8-48.23/InTRO/InTRO.html	INTRO is dedicated to providing professionals in the field of Instructional Technology with an electronic forum to disseminate, discuss and advance research in instructional technology and related fields.

Name	Internet Address	Description
Internet Resources for Institutional Research	http://apollo.gmu.edu/~jmilam/air95.html	To assist institutional researchers and higher education faculty and students in navigating the Internet.
Journal of Statistics Education (The) – JSE	http://www2.ncsu.edu/ncsu/pams/stat/info/jse/homepage.html	The Journal is a refereed journal on postsecondary teaching of statistics. This site includes the Current Issue; JSE-Talk (an electronic forum devoted to commentary and discussions pertaining to articles and regular features appearing in the Journal); Search JSE (full text search of all articles in the Journal); JSE Data Archive; and Feedback (allows reader to provide staff with comments and insight concerning journal policy, technical questions, or other issues).
KIDLINK	gopher://kids.ccit.duq.edu:70/1	KIDLINK information found in this gopher is intended to help youth ages 10-15 get involved in a global dialogue through e-mail and other telecommunications exchanges. This site includes, among others, KIDLINK in the classrooms; KIDLINK people; KIDART Computer Art Gallery; research reports, papers and newsletters; KIDSHOW and other multimedia programs; and full text search of all files available on this server.
LAW	http://www.einet.net:80/galaxy/Law.html	The site includes legal topics; laws and regulations; legal articles, books, collections and periodicals; legal directories; and academic and commercial organizations.
Learning Research and Development Center, University of Pittsburgh	http://www.lrdc.pitt.edu/welcome.html	The purpose of the Center is to broaden scientific insights into all aspects of learning, and to support the use of research in instructional settings as varied as classrooms, industries, and museums.
Long Island Educator (The)	http://www.computel.com/~tmangia/lied.html	Defined as an on-ramp to the Information Super-Highway. Comprises professional resources; libraries; subject areas (lesson plans and articles for teachers); technology on Long Island; electronic field trips; the faculty electronic collaboration room; local schools on the Web; and a help desk.
Mathematics Archives	http://archives.math.utk.edu/	Contains software and other materials which can be used in the teaching of mathematics at the community college, college and university levels.

Name	Internet Address	Description
Michigan Department of Education	http://web.mde.state.mi.us:1024	The gopher is designed to facilitate communication and information sharing between the Department of Education and the education community in Michigan. It provides Department personnel, students, teachers, administrators, parents, and others free access to a broad range of Internet-based educational resources. The gopher provides information on the State Board of Education and the State Superintendent. It also comprises legislation, state aid and Michigan government information; offices and programs of the Department of Education; Department personnel directory; school reports, information and statistics; grants and funding resources; technology for education; classroom and teacher resources and information; professional educational organizations; and other State of Michigan gophers and Internet resources.
MidLink Magazine	http://longwood.cs.ucf.edu:80/~MidLink	MidLink Magazine is an electronic magazine for kids in the middle grades -- generally ages 10 to 15.
Minority Scholarships and Fellowships	http://web.fie.com/htbin/cashe.pl	Provides search tools for scholarship and fellowship information for minorities.
National Academy of Sciences (The)	gopher://gopher.nas.edu:70/1	The Academy is a private, nonprofit society dedicated to the furtherance of science and technology, and for their use for the general welfare.
National Center for Research in Vocational Education (NCRVE)	gopher://vocserve.berkeley.edu:70/1	NCRVE is the nation's largest center for research and development in work-related education. This NCRVE gopher server is under development.
National Center for Research on Teacher Learning	gopher://burrow.cl.msu.edu:70/11/internet/msu/ncrtl	The Center shifted its emphasis in 1991 to teacher learning, reflecting its desire to provide leadership in defining this new area of research. The server includes issue papers; craft papers; conference papers and research reports; and the technical series abstracts.
National Center on Adult Literacy	http://litserver.literacy.upenn.edu	The Center was created to provide national research and development leadership in the field of adult literacy, and improve the quality of adult literacy programs and services on a nationwide basis.

Name	Internet Address	Description
National Center on Postsecondary Teaching, Learning and Assessment	gopher://genesis.ait.psu.edu:70/11/inside/Research%20Centers%20and%201	The Center is a research, development, and dissemination center attempting to focus the attention of the postsecondary education community and its several constituencies on teaching and learning, the improvement of educational practice, and the advancement of theory and practice in the assessment of student and institutional performance. The Gopher comprises a staff directory; Upcoming Higher Education Events; Summary of NCTLA Research Projects and Findings; NCTLA Newsletter; and Materials Produced by NCTLA.
National Clearinghouse for Bilingual Education	gopher://gopher.ncbe.gwu.edu:70/1	The purpose of the Clearinghouse is to collect, analyze, and disseminate information related to the education of linguistically diverse students in the United States. It produces Program Information Guides; FOCUS; FORUM; and Directions in Language and Education.
National Clearinghouse for Math and Science Education	gopher://gopher.cic.net:3005/11	The Eisenhower Clearinghouse is a comprehensive, multimedia collection of materials and programs for K-12 mathematics and science education. The ENC collection includes materials in a variety of print, audio, video and electronic formats.
National Diffusion Network	gopher://gopher.ed.gov:70/11/programs/NDN	A Federally-funded dissemination system to help public and private schools, colleges and other educational institutions improve by sharing successful education programs, products, and processes.
National Institute for Literacy	http://novel.nifl.gov	The Institute will advance the nation's agenda with special emphasis given to building public consensus and policy; monitoring programs; sponsoring promising initiatives; disseminating valid information on programs and research pertinent to literacy; and building interagency collaboration at the Federal and state levels.
National Parent Information Network	gopher://ericps.ed.uiuc.edu:70/11/npin	The Network provides information and foster electronic communications among parents and those who work collaboratively with them. Publications, brochures, and other materials listed in this site have not been reviewed and are included only for informational purposes.
NetSchool Project	http://netschool.edu	Starting to build the first K-12 school on the Internet. The school is intended for students that wish to take a more aggressive role in their own education by helping create the first K-12 Internet school.

Name	Internet Address	Description
New Generation Education	http://www.hsr.no/~nge	An attempt to design an alternative education system that better suits the needs of current and future students in current and future societies.
New York Public Library	http://gopher.nypl.org/	The gopher site includes information about the New York Public Library; the research libraries (i.e., The Center for the Humanities, the New York Public Library for the Performing Arts, Schomburg Center for Research in Black Culture, and Science, Industry and Business Library); the branch libraries (including the Andrew Heiskell Library for the Blind and Physically Handicapped, Donnell Library Center, Mid-Manhattan Library, and the NY Public Library for the Performing Arts); neighborhood branches (the Bronx, Manhattan, Staten Island); New York City Government (New York City Council, and New York City Community Boards); and searching the Internet.
New York State Education and Research Network (NYSERNET)	gopher://nysernet.org:70/1	NYSERNET is a high-speed data network, connecting New York State to the global community of computing networks and resources known as the Internet. The gopher has been developed to provide information about NYSERNET; links to general information resources; reference documents about using the Internet; software distribution for MACs and Pcs; and various NYSERNET publications.
New York State Education Department	http://www.nysed.gov gopher://vm1.nysed.gov.home.html	Operated by the New York State Education Department as a service of the Technology Network Ties program. Includes New York State Education Department Resources (i.e., Looking Toward 2000, a Mission Statement, and access to the State Archives and Records Administration, the Government Information Locator, and the New York State Library).
New York State Library	gopher://unix2.nysed.gov:70/1	The gopher is intended to serve as the Government Information Locator System for New York State, and make available a variety of State documents and publications. It includes Government Agencies; Government Information Locator; New York State Library Information; Search the Catalog; United States Government Information; search other library catalogs; search the Internet; other gopher and information servers; and Freenets.

Name	Internet Address	Description
North Carolina Department of Public Instruction	http://www.dpi.state.nc.us	Comprises the Educator's Resource Center; Education in North Carolina; NCDPI (organizational information, instructional contacts, publications, reports and guides); and the most frequently accessed pages from this site.
North Country Reference and Research Resources Council	gopher://aldus.northnet.org:70/1	The Council is a multiple library cooperative serving academic, special, hospital, law, public, corporate, and museum libraries and library systems in the seven counties of rural northern New York. This site comprises area libraries and catalogs; data and databases; educational resources K-12; electronic journal; Internet Help; North Country RRR Council Publications; other 3R Council and library Catalogs; and other gophers and gopher tools.
Ohio Board of Regents	http://www.bor.ohio.gov/	The Board plans for higher education in the state, considering the needs of the people, the state, and the role of individual public and private institutions within the state in fulfilling those needs. This website comprises programs (i.e., articulation and transfer, institutional support, medical support, financial aid, public service, and coordination initiatives); planning documents; gopher (i.e., strategic planning, committees, councils and task forces, college and university information, student financial aid information, opportunities, OhioLink, other gophers, and other information systems); general information; other higher education links; and other Ohio Government servers.
Ohio Department of Education	gopher://odevs1.ode.ohio.gov	Includes information on the history of the County Board of Education; Ohio Department of Education Resources; and other items.
Oklahoma State Regents for Higher Education	http://mirage.osrhe.edu	This site provides information on higher education coordination in Oklahoma; governance; center governance; higher education programs; private colleges and universities; and proprietary institutions.
Online Education, The Electronic University, University of Paisley	http://www.online.edu/index.htm	Provides degree courses in an advanced electronic format with a networked academic support system.
Pluribus Unum, Teachers College	gopher://pluribus.tc.columbia.edu:70/1	The gopher is devoted to the study of diversity and school administration, K-12.
Projections of Education Statistics to 2004	gopher://gopher.ed.gov.:10000/11/publications/majorpub/projections	This site provides a copy of the Projections, and allows the user to access discreet chapters of the document separately.

Name	Internet Address	Description
Regional Educational Laboratories, U.S. Department of Education	http://www.yahoo.com/Government/Agencies	Provides access to all United States Department of Education regional educational laboratories.
Regional Laboratory for Educational Improvement of the Northeast & Islands	http://www.neirl.org	The Laboratory works with educators, policy-makers, parents, and others concerned about the welfare of children to ensure that all children learn and achieve. This website includes education resources (i.e., NEMOnet, the Educational Technology Bibliographic Resource Guide, Opportunity-to-Learn Standards, School Emergency Response Plan: Draft, Goals 2000: Educate America Act - Summary and Analysis, Pathways, the Regional Alliance for Mathematics and Science Education Reform, School-Based Management: Report on Recent Literature, January 1994, Creating New Visions for Schools, School-Family Partnerships - Report on Recent Literature, January 1994, the Regional Lab and Cutting Edge Reports, the Northeast Common Market, and story ideas for education reporters); and other information servers.
Research for Better Schools (RBS)	gopher://gopher.rbs.org:70/11	RBS is a private, nonprofit corporation that provides educational development, evaluation, technical assistance, and training services under client funding within the region, and operates a self-supporting publications division on a national basis. This site includes RBS announcements, newsletters and updates; the Educational R&D Network; resources for urban education, and rural education; K-12 resources; Philadelphia area gophers; gopher servers worldwide; search the Internet (by Veronica, Jughead, Archie, WAIS, WWW); and search this server using Jughead.
Science World	http://scienceworld.bc.ca/	Science World is a nonprofit, self-supporting organization dedicated to inspiring a greater appreciation of science and technology through the presentation of science exhibitions and demonstrations, informal educational activities and outreach programs in British Columbia. This site comprises general information; programs and events; school trip information; Science World membership; history of Science World; outreach information; scientists and innovators in the schools; science fairs; and links to other science and education sites.

Name	Internet Address	Description
Science Learning Network	http://sln.fi.edu	The Network will offer training for teachers and help design resources for teachers and students through the use of the Web's "hyper-linking,"a technology that creates links among related documents regardless of where they are physically located on the computer network.
Scientific Research and Higher Education Center of Ensenada, México	http://www.cisese.mx	The Center conducts research, provides technological and scientific assistance, develops human resources, and supports the creation of high technology corporations in the areas cultivated by the Center. Documents are in Spanish.
SciLink	gopher://scilink.org	SciLink is an educational computer conferencing network founded in 1989 to serve the special needs of science, math, and technology educators. It includes KidLink. Projects; Kids from KANATA;Nova Scotia technology Net; other gopher and information servers; School Net Gopher; and SciLink login.
Sloan Foundation	http://www.sloan.org	The main interests and programs of the Foundation are concentrated primarily on education and careers in science and technology, standard of living, competitiveness and economics, and selected national issues.
South Dakota Board of Regents	http://www.ris.sdbor.edu	This site includes information about the Board of Regents, including the Fiscal Year 1995 Factbook, and World Wide Web sites of interest (list of popular WWW sites, WWW browsers, Help with HTML, colleges and universities, Federal government, WWW Search Machines, and White Pages).
STAR Schools	gopher://gopher.ed.gov:70/11/programs/starschools	To provide improved education in mathematics, science, and foreign language as well as literacy and vocational education through the establishment of telecommunications partnerships.
Student Financial Aid	http://www.usbanksl.com	This website comprises information about U.S. Bank; financial aid programs; hot links to other sites including financial aid information; and other aid information.
Teacher Education Information Server (TEIS)	gopher://state.virginia.edu:70/11/teis	The Server was established to explore the ways in which the Internet could benefit teacher education programs around the world. It provides access to two of the most widely used services, archived documents and interactive discussion groups.

Name	Internet Address	Description
Technology and Information Educational Services (TIES)	gopher://ties.k12.mn.us:70/1	TIES, Technology and Information Educational Services, established in 1967, is a nonprofit computer consortium composed of 49 school districts. TIES serves 400 schools with an enrollment of 279,000 students.TIES has extensive expertise helping educators apply technology to education in the administrative and instructional areas. Additionally, TIES trains over 15,000 educators per year on the use of technology in the classroom. TIES' mission is to provide leadership in the application of technology to education by means of quality support services, training, consulting, processing, and research and development, so that member districts can achieve enhanced learning for students and cost-effective management.
Texas Education Agency	http://opsul.tea.texas.gov:70/1	An information management tool provided by the Texas Education Agency. The gopher menu includes Academic 2000; education legislation and court rulings; Commissioner and State Board of Education; fund balances (contain fund balance statistics and the text report of Texas public schools); the Academic Excellence Indicator System (provides a wide range of information on the performance of students in each school and district in the State, and extensive information on school and district staff, finances, programs and demographics); State funding worksheets; career and technology education; adult and community education; the TEA Clearinghouse; the Texas Electronic Library; and the Texas Information Highway.
Texas Higher Education Coordinating Board	gopher://info.thecb.texas.gov:70/1	The mission of the Board is to provide the Legislature with advice and comprehensive planning capability to higher education, to coordinate the effective delivery of higher education, to efficiently administer assigned statewide programs, and to advance higher education for the people of Texas. The gopher comprises the Board's agenda and minutes; rules and regulations; facts on higher education; degree programs; cost of education; financial aid for Texas college students; research in Texas higher education (including a research needs list prepared by other agencies and commissions); transfer guides for colleges and universities; requests for proposals; Public Higher Education Information Center; electronic discussion groups; and other gophers.

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Name	Internet Address	Description
United States Department of Education	http://www.ed.gov	This site provides information on the Department's mission; National Education Goals; Teacher's Guide to the U.S. Department of Education; Researchers Guide; major Department programs; organization of staff, staff locator, and facilities; Departmentwide initiatives; newsletters; press releases and funding opportunities; selected speeches and Congressional Testimony by the Secretary of Education; hypertext versions of recent publications; and other educational resources.
Universities	http://www.yahoo.com/Education/Universities	Universities from throughout the world.
University of Alaska Board of Regents	http://info.alaska.edu:70/1s/UA/BOR	Includes information on Board members, meeting schedules, committee appointments, Regents policy, Board agendas, and minutes.
University of Puerto Rico, Central Administration	http://www.upr.clu.edu/home.html	The University of Puerto Rico comprises 11 institutional units, including 3 university campuses, 3 colleges, and the 6 institutions belonging to the Regional Colleges Administration. This site provides access to other home pages (i.e., Inter American University, the Arecibo Astronomy Observatory, experimental program to stimulate competitive research, and cultural activities), and other Latin American and Caribbean sites (i.e., resources for the study of Latin America, the Latino Link, the Caribbean Connection, and CaribeNet).
UPRNet	http://www.upr.clu.edu/english/uprenet.html	Interconnects the administrative, educational, and research computing services of the University of Puerto Rico.

Name	Internet Address	Description
Urban Education National Network (UENN)	gopher://gopher.rbs.org:70/11/Urban/uenn	Established in 1993 to support the restructuring efforts of the nation's urban school districts. The UENN seeks to identify the knowledge base of theory and practice that will inform decisions relevant to closing the achievement gap, and commission a series of papers to synthesize research in critical areas; assemble a descriptive resources notebook of products and initiatives that address the key areas of the knowledge base needed to close the achievement gap; suggest areas in the work of the Regional Educational Laboratory Network (REL) system needing further attention to support urban schools and school districts; and hold a national forum and/or make presentations at key national conferences of urban educators to disseminate the knowledge base consolidated from the commissioned papers and the display of pertinent REL resources.
Video Journal of Education (The)	http://vje.com/vje	The Journal was developed to give administrators and teachers the opportunity to improve their skills. It allows the user to learn more about the latest in educational professional development. Specific videos are highlighted at random.
Wisconsin Department of Public Instruction	http://badger.state.wi.us/o/agencies/dpi/www/dpi_home.html	This site comprises popular websites to visit; education and library resources; information from the Department of Public Instruction (overview of the Department; agency staff directory; bulletins and press releases; publications catalog; the Early Childhood "Bright Beginnings" Program; Exceptional Education; Family-Community-Schools Partnership Team; the Urban Initiative Task Force), other Wisconsin Government and State Resources; and appendices (i.e., more education and library-related resources, Wisconsin Division for Libraries and Community Learning).
Youth Indicators, 1993	gopher://gopher.ed.gov:10000/11/publications/majorpub/youth	This site provides a copy of the Youth Indicators, and allows the user to access discreet chapters of the document separately.
120 Years of American Education	gopher://gopher.ed.gov:10000/11/publications/majorpub/120yr	This site provides a copy of the 120 Years of American Education, and allows the user to access discreet chapters of the document separately.

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Name	Internet Address	Description
Administration for Children and Families, U.S. Department of Health and Human Services	http://www.acf.dhhs.gov	The Administration for Children and Families (ACF) is part of the U.S. Department of Health and Human Services. This site provides information on ACF programs and services (Administration for Native Americans, Aid to Families with Dependent Children, At-Risk Child Care, Child Care and Development Block Grant, Child Support Enforcement, Child Welfare Services, Community Services Block Grants, Developmental Disabilities, Family Preservation and Support, Foster Care and Adoption Assistance, Head Start, Job Opportunities and Basic Skills Training, and others); organizational structure and staff information; ACF in the News; and other Internet information resources, including the Reference Shelf (American English Dictionary, area code and city/zip code lookup, postal abbreviations, Roget's Thesaurus, U.S. Census Info, Webster's Dictionary, and world maps).
American Memory Historical Collections for the National Digital Library	http://RS6.loc.gov	Consists of collections of primary source and archival material relating to American culture and history. The elements in each historical collection include digital reproductions of items, a finding aid, and various accompaniments.
Bureau of Labor Statistics, U.S. Department of Labor	http://stats.bls.gov	This site provides information about major BLS programs, databases, regional offices, and contacts. It provides access to the LABSTATgopher menu.
Central Intelligence Agency (CIA)	http://www.odci.gov	The general site for the CIA, comprising information about the agency, CIA publications, and additional CIA links.
Central Intelligence Agency, The World Fact Book	http://www.odci.gov/94fact/fb94bc/fb94toc.htm	Provides comprehensive information about each country, and information on how to purchase relevant publications, maps and other materials.
Congressional Quarterly Gopher (The)	gopher://gopher:cqalert.com:70/1	This gopher allows Internet users to explore the Congressional Quarterly data files, both current and archival.
Economic Bulletin Board, Department of Commerce	gopher://una.hh.lib.umich.edu/11/ebb	One stop source of current economic information.

Name	Internet Address	Description
Environmental Protection Agency (EPA)	http://www.epa.gov	Provides information about the agency and environmental data (press releases, calendar, announcements and speeches; consumer information; EPA initiatives, policy and strategy documents; rules, regulations and legislation; EPA standards; science, research and technology; information about grants, contracts (RFPs, and job vacancies; newsletters and journals; and software and databases). It also allows the user to submit a text search form.
FedWorld Information Network	http://www.fedworld.gov	The goal of FedWorld is to provide a one-stop location for the public to locate, order and have delivered to them, U.S. Government information. It provides access to more than 130 dial-up bulletin boards. Not all the bulletin boards are available on line.
Governmentwide Electronic Messaging Program Management Office	http://www.fed.gov	This server is designed for Federal employees who wish to gain more knowledge on electronic messaging and related applications; however, any e-mail and/or Internet user may find the information provided beneficial.
Internal Revenue Service	http://www.ustreas.gov/treasury/bureaus/irs/irs.html	The purpose of the Internal Revenue Service is to collect the proper amount of tax revenue at the least cost to the public in a manner warranting the highest degree of public confidence in the IRS' integrity, efficiency, and fairness. The site includes tax forms and instructions; frequently asked questions; where to file; and where to get help with taxes.
Library of Congress (The), MARVEL	http://www.loc.gov/	A campus-wide information system that combines the vast collection of information available about the Library with easy access to diverse electronic resources over the Internet. It includes information about exhibits and events; services and publications; digital library collections; LC Online Systems; Congress and Government; and indexes to other World Wide Web servers.

Name	Internet Address	Description
National Clearinghouse for Alcohol and Drug Abuse	http://www.health.org	It comprises the NCADA online services; the Prevention Primer; the 1993 National Household Survey on Drug Abuse; the 1993 Preliminary Estimates from the Drug Abuse Warning Network; Overview of the National Drug and Alcoholism Treatment Unit Survey (NDATUS): 1992 and 1980-1992; Evaluation News; and the Search the Citizen's Guide to Prevention Resources. It also provides links to other Internet resources such as Join Together Online, and PAVNET (Partnerships Against Violence Network).
National Crime Justice Reference Service (NCJRS)	gopher://ncjrs.aspensys.com:71	The gopher is designed to provide information about the Office of Justice Programs and Office of National Drug Control Policy Services, publications, and products, as well as other direct access to the NCJRS Bulletin Board System. In addition, the gopher is designed to provide immediate access to other criminal justice resources across the Internet.
National Endowment for the Humanities	http://www.neh.fed.us	This site provides information about the National Endowment for the Humanities, an independent agency of the United States Government, that makes grants for projects in history, languages, philosophy, and other areas of the humanities.
National Museum of Natural History	http://nmnhwww.si.edu/nmnhweb.html	An Internet resource compiled and maintained by the staff of the National Museum of Natural History. It includes documents and data about Museum research and the national collections, which comprise more than 120 million scientific specimens and cultural artifacts from around the world.
National Research Council (NRC)	gopher://xerxes.nas.edu:70/00/nrc	Organized by the National Academy of Sciences in 1916 to associate the broad community of science and technology with the Academy's purposes of further knowledge and advising the Federal government.
National Science Foundation (NSF)	http://www.nsf.gov	The agency's mission is to promote the progress of science and engineering. This site provides information on the NSF organization and staff; program deadlines; grant/research opportunities; science trends/statistical information; News Media; science education; and external links.

Name	Internet Address	Description
New York State Archives and Records Administration (SARA)	gopher://unix6.nysed.gov	This gopher is operated by the New York State Archives and Records Administration (SARA) State Government Records Programs. SARA identifies, preserves and makes available for research the permanently valuable records created by New York's colonial and state government agencies, legislatures, and judiciary. SARA's State Government Records Programs also provides centralized records and information management services for New York State government. The SARA gopher provides researchers information on using State Archives records; information on policies governing access to records, access to descriptive information about records in the Archives; information on records available for specific research interests; and access to finding aids for records preserved by the Archives. The SARA gopher also provides information on records management services to New York State government agencies. These services include training and education programs, programs for managing electronic records, and policies and procedures for managing State government records.
New York State Assembly	gopher://assembly.state.ny.us	To help keep the public informed on its activities, the New York State Assembly maintains a Legislative Information System on the Internet. This system is accessible to anyone who can use the Internet's telnet function. The system allows the user to review detailed information on legislation in the current two-year legislative session; read the full text of a bill, check its current status in the legislative process, and even browse the sponsor's Memorandum in Support; and review Assembly committee and floor calendars, find out when and where public hearings are being held, and explore the State Constitution and laws of New York State.
New York State Court of Appeals	http://www.law.cornell.edu/ny/ctap/overview.html	Provides access to decisions of the New York State Court of Appeals from January 1992 (indexed by topic, or key word search), and statutes governing jurisdiction of the Court (Article 56 of the New York Civil Practice Law & Rules).
New York State Department of Economic Development	http://www.nysernet.org/i-love-ny/index.html	Provides information about the State's tourism sites and points of interest, and the State's geography, motto, bird, flag, fruit, tree, flower, muffin, fish, animal, gem and fossil.

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Name	Internet Address	Description
New York State Department of Health	gopher://gopher.health.state.ny.us	The gopher provides general health-related information and access to data resources, and serves as a guide to public information, data, and services provided by the New York State Department of Health.
New York State Office of General Services, State Contracts Database	gopher://ogs.nysernet.org	The purpose of this pilot program is to make New York State term contract documents readily available to State agency customers for viewing or downloading through electronic access over the Internet. The system was designed to provide a fast and easy way to find a term contract award or text information contained in a contract award.
New York State Senate	gopher://gopher.senate.state.ny.us:70/1	This site includes the New York State Senate Member Directory; Senate Legislative Schedule; Senate Rules; Senate Committee Membership and Schedule; Legislative Public Hearings; Senate Reports; the New York State Government Information Locator; and New York State Legislative Bill Information.
Public Broadcasting Service	http://www.pbs.org	Comprises What's New; About PBS; National Programming; Learning Services; PBS Store; and Search PBS WWW Site.
Smithsonian Institution	http://www.si.edu	The SI Web is an effort the Smithsonian has undertaken to facilitate the access of a national and international audience. It includes a Museum Overview; Encyclopedia Smithsonian; Planning a Visit; and other information about activities, perspectives, resources, and products.
Social Security Administration	http://www.ssa.gov	This site includes a history of the Social Security; benefit information; rulings; "En Español," Online Services; forms [available for download in both Postscript and Portable Document Format (PDF)]; Policy Forum; statistics; legislation; international; employer information; search; and other servers of interest.
Statistical Abstract of the United States, 1994	http://www.census.gov/stat_abstract	It contains a collection of statistics (over 1,400 tables and graphs) on social, economic and international subjects. In addition, the Abstract is a guide to other data from the Census Bureau, other Federal agencies, and private organizations.

Name	Internet Address	Description
Substance Abuse and Mental Health Services Administration (SAMHSA)	http://www.samhsa.gov	The mission of the Administration is to improve the quality and availability of prevention, treatment, and rehabilitation services in order to reduce illness, death, disability, and cost to society resulting from substance abuse and mental illnesses. This website includes SAMHSA's programs and services; 1995 Strategic Plan; and other related Internet resources.
Tiger Map Service Experimental Browser	http://tiger.census.gov	The main purpose of the TIGER Map Service project is to provide a good-quality, national scale, street-level map to users of the World Wide Web. This service is freely accessible to the public, and based on an open architecture that allows other Web developers and publishers to use maps generated by this service in their own applications and documents. The TMS has come about for two main reasons: (1) there is a demand from many users and developers on the World Wide Web for easily-accessible street-level and regional maps for places in the United States, whether for general viewing, research and analysis, usage in interactive map-based services, or inclusion as illustrations in documents; and (2) the Census Bureau, as the nation's only maintainer of a national public-domain street level database, was the most obvious candidate as a provider of such a service.
U.S. Bureau of the Census	http://www.census.gov	The Bureau of the Census collects data about the people and economy of the United States, and produces a variety of statistical data products including printed reports, statistical briefs, and computer files on tape and CD-ROM media. Access to some of the data is provided at this site.
U.S. Constitution	http://www.law.cornell.edu	This website provides access to the U.S. Constitution and related legal documents, including the U.S. Code and the Cornell Law Review.
U.S. Copyright Office	gopher://marvel.loc.gov/11/copyright	The site provides information about the Copyright Office, and provides access to other sources relating to copyright available through the Internet.
U.S. Geological Survey (USGS)	http://www.usgs.gov	This site includes fact sheets; general information; relevant contacts; public issues; education; USGS Information releases; environmental research; geographic information systems; data products; and network resources.

Name	Internet Address	Description
U.S. House of Representatives	http://house.gov orgopher://house.gov:70/1	Provides public access to legislative information as well as information about Members, Committees, Organization of the House, and to other U.S. Government information.
U.S. Senate	gopher://ftp.senate.gov:70/1	Menu selections are provided on this server for both Senators and Senate Committees. A centralized directory of Senators' and other Senate offices' Internet electronic mail addresses has been made available on the main menu.
White House (The)	http://whitehouse.gov	This site is defined as an Interactive Citizen's Handbook, and comprises the Executive Branch; the First Family; tours; What's New; publications; comments; President's Welcome Message; Vice President's Welcome Message; and a guest book.

MISCELLANEOUS

Name	Internet Address	Description
America's Job Bank	http://www.ajb.dni.us/about.html	Publicizes job listings on a national basis.
Association for Practical and Professional Ethics	http://ezinfo.ucs.indiana.edu:80/~appe/home.html	The Association is committed to encouraging high quality interdisciplinary scholarship and teaching in practical and professional ethics by educators and practitioners who appreciate the theoretical and practical impacts of their subjects. This website includes information about the Association; membership; Association activities and publications (including Ethically Speaking, and Profiles in Ethics); and electronic networking opportunities.
Boston Book Review (The)	http://bookwire.com/bbr/bbr-home.html	This site provides book reviews written by preeminent experts in many fields (i.e., fiction and criticism, Children's Corner, life and letters, poetry and poetics, arts and diversions, audiobooks & CD-ROM, history, politics and polemics, and science and other humanities); the BBR Bookbag; and interviews and essays.
Career Magazine	http://www.careermag.com/careermag	A comprehensive resource designed to meet the individual needs of networked job seekers.

Name	Internet Address	Description
CityNet	http://www.city.net	This website is a comprehensive international guide providing easy and timely access to information on travel, entertainment, and local business, plus government and community services for all regions of the world.
Computer Professionals for Social Responsibility (CPSR)	gopher://gopher.cpsr.org	The CPSR is a national public-interest electronic resource concentrating on the impact of technology on society. The site includes the Computer Professionals for Social Responsibility Main Directory; Cypherpunk Archive Mirror from soda.berkeley.edu;fpt; incoming; net info; sunnyside; and taxpayer assets.
Cornucopia of Disability Information (CODI)	gopher://vienna.hh.lib.umich.edu/11/health/disabilities	CODI is a gopher intended to serve as community resource for consumers and professionals by providing, via the Internet, disability-related information in a wide variety of areas. This site includes search-tools; New York State and local services; college services and resources; national information sources on disabilities; statistics; government documents; computing; legal; publications; network resources; aging; other directories; Directory of Independent Living Centers; bibliographic information; the National Rehabilitation Information Center (NARIC); ABLEDATA;universal design; employment; and announcements.
Council of the Great City Schools	http://www.cgcs.org/	This site comprises What's New (Legislative Alert, The Urban Source, and Urban Educator); general (i.e., the Council, member districts, newsletters, Council Reports, and Conference Highlights); and member services (i.e., legislative, research, technology, management, public information, instruction and standards, and the Great City Kids Network).
Counterpoint Publishing's Daily Federal Register	gopher://gopher.counterpoint.com:2002/11	This is a subscription-based service available, providing daily updates of the Federal Register via the Internet.
Economist (The)	http://sosig.esrc.bris.ac.uk/subjects/econ.html	A weekly publication that reports on politics, economics, business, and technology.

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Name	Internet Address	Description
Educational Technology Review Center (ETRC)	http://www.cacs.us/.edu/Departments/ETRC	The mission of the Educational Technology Review Center (ETRC) is to serve as a research center and clearinghouse, and provide an impetus for change in the educational community through the access to state-of-the-art technology, in-service training, and implementation of technology into the curriculum. The site includes current projects; the educational newsletter; educational resources; and Meet our Educators and Staff.
Electronic Activist (The)	http://www.crocker.com/~ifas/activist/newyork.html	This site allows the user to send messages to members of the United States Congress, the New York State Legislature, and the media.
Electronic Zoo (The)	http://netvet.wustl.edu/e-zoo.htm	The site comprises About E-Zoo; What's New; Search; Animals; Veterinary; Washington University; mailing lists; telnet; FTP sites; publications; newsgroups; gophers; and websites.
Foundation Center (The)	http://fdncenter.org/cgi-bin/imagemap/main2	It includes information about the Foundation Center; libraries and locations; training opportunities; Philanthropy News Digest; Grantmaker Information; and publications and services.
Institute of Electrical and Electronic Engineers, Inc. (The) -- IEEE	http://ieee.org:80/./i3e-hp.html	This website includes member services; the IEEE Bookstore; IEEE Technical Societies; student activities; local activities and IEEE Officer Information; IEEE publications (i.e., Spectrum Magazine, THE INSTITUTE); and links to other sites.
Internet Public Library (The) -- IPL	http://ipl.sils.umich.edu/	The Library features several divisions, including reference, youth, librarian services and MOO (Multi-User Object Oriented Environment), as well as the Classroom, Exhibit Hall and Reading Room, a directory of services and tour and a Web searching capacity. The site also includes information about the Library's Statement of Principles, Mission Statement and Goals, the Board of Trustees, and policies regarding requests to reconsider resources and release of access log information.
LatinoLink	http://www.latinolink.com	This site comprises LatinoLink News, LatinoLink Commentary, LatinoLink Life, LatinoLink Business, LatinoLink Travel, LatinoLink Entertainment, LatinoLink Art, LatinoLink Archive, and feedback. It contains stories, columns and photographs by Latino journalists, and The Latino Reporter -- the official newspaper of the National Association of Hispanic Journalists.

Name	Internet Address	Description
McKinley Internet Directory (The)	http://www.mckinley.com	An online directory of described, rated and reviewed Internet resources and other key facts instantly accessible to users. The Directory contains currently over 20,000 evaluated, reviewed and rated sites, and 60,000 sites which are briefly described but not yet rated.
Meta Network	gopher://tmn.com	The site includes organization development, management, business, TQM, chaos; Technology and Society; Arts Wire; ARTSEDGE Information Gallery; education; National Performance Review Information; government and politics; Federal Energy Management Program; Law and Justice (information of interest to attorneys); humanities; access to other gopher servers; amusements, and Ashoka -- Innovators for the Public.
National Center for State Courts	http://www.ncsc.dni.us.ncsc.htm	The National Center is an independent, nonprofit organization dedicated to the improvement of justice. This site comprises Court Technology Programs; research; Institute for Court Management; Court Services Division; Office of Government Relations; staff e-mail addresses; court information; Courtroom 21; and court and law related Internet sites.
National Rehabilitation Information Center (NARIC)	gopher://www.cais.com:80/HGET%20/naric/home.html	The Center is a library and information center on disability and rehabilitation. NARIC collects and disseminates the results of Federally-funded research projects. The gopher menu includes Serials Survey; Rehab Briefs; REHABDATA;Electronic Industries Foundation; Who Tracks the Literature of Disability/Rehabilitation?; and publishers of disability and rehabilitation books.
NETOPEN, Multilingual Directory of Services	www.indra.com/jewels/cybercom/netopen/	Nothing in the directory yet. Contributions are being requested.
New York Metropolitan Reference and Research Library Agency (METRO)	http://metro.org	A cooperative of over 250 libraries and library systems in the metropolitan New York area. With links to METRO region Web Sites, gophers and academic, medical, school and public library OPACs, METROWeb provides the most comprehensive, continuously updated listing of New York Metropolitan area library and library-related resources available anywhere on the Internet.

Name	Internet Address	Description
Project America	http://www.mit.edu:8001/activities/project-america/homepage.html	Project America is a nonprofit organization whose mission is to inspire and teach people across the country to take positive steps to improve their own communities, and to facilitate partnerships between volunteers and the organizations that need them. This site includes Project Handbook (providing ideas of the types of projects that could be organized, and contains information to help organize a quality project); and the Resource Directory.
Shuttle Atlantis Mission	http://shuttle.nasa.gov	Designed to give visitors the opportunity to experience a space shuttle mission through access to detailed, up-to-the-minute multimedia information during each flight. The site comprises Mission at a Glance; STS-70 Crew; Visitor Sign-In; Shuttle Reference; search; Preflight, Launch, Orbit, and Landing; and the Photo and Video Gallery.
Small Business Development Research Network	http://www.smallbiz.sunycentral.edu	The primary function of the Network is to facilitate the exchange of information or ideas among Small Business Development Centers, the Small Business Administration, and the entrepreneurial community. It includes information on the library collection; site location; staff; Bulletin Board Service; and Information for Entrepreneurs.
StatLib	gopher://lib.stat.cmu.edu	The main purpose of this server is to present a gopher view of the StatLib archives. The archives contain a large collection of statistics software, data, directory lists, and random material (i.e., Journal of Statistics Education Information Service, Statistical Computing and Graphics Newsletter, the National Notifiable Disease Data, algorithms and abstracts from the Journal of Computational and Graphical Statistics). StatLib includes the source to entire statistics packages, the collection of Applied Statistics algorithms, the archives of the s-news mailing list, and so on.
Syllabus Web	http://www.syllabus.com	SyllabusWeb is a free service from Syllabus Press. It comprises highlights of recent issues of Syllabus magazine which cover telecommunications and networking, and provides the means to receive a free subscription to Syllabus Magazine – a magazine for high school, college and universities.

Name	Internet Address	Description
Training Registry	http://www.tregistry.com/ttr/	The Training Registry is a searchable online catalog of onsite, public, and media based training course offerings on a wide of topics and from a variety of vendors. Internet users browse free of charge training course and vendor information. The Training Registry provides one-stop shopping for those looking to comparison shop for training course offerings.
UIUC Advanced Information Technologies Group	http://aitg.soc.uiuc.edu/AITGHHome.html	The Group seeks to advance the research and instruction by faculty in the humanities and social sciences in the areas that are either focused on or employ advanced information technologies. This site includes members of the AITG Advisory Committee; AITG's current projects; important dates; funding agencies, programs, foundations, etc. of note; and links to other advanced information technology pages.
United States of America Home Page	http://sunsite.unc.edu/usa/usahome.html	With a U.S. map as a reference tool, allows the user to point to any state and obtain information online.
Villanova Center for Information Law and Policy	gopher://ming.law.vill.edu	The site comprises the National Center for Automated Information Research (NCAIR); the Villanova Information Law Chronicle; the Villanova Tax Law Compendium; the Legal Domain Network - Legal Information on the Internet; available legal information and services; and other services (i.e., Continuing Legal Education: Philadelphia Bar Education Gopher; Third Circuit Court of Appeals Bulletin Board, courses).
Virtual Reference Desk (The)	http://thorplus.lib.purdue.edu/reference/index.html	The site comprises dictionaries, thesauri and acronyms; information technology selected documents on planning for and using Information Technology; maps and travel information; periodic tables, and weights and measures; phone books and area codes; selected Indiana and U.S. documents; zip and international country codes; and other reference sources (i.e., selected dissertations, Vanderbilt News Archive, South Bend Tribune Index, Online Reference Works, Nova Reference Shelf).
WebCrawler	http://webcrawler.com/	The WebCrawler was created by the WebCrawler robot, a software program that gathers and indexes URLs as it surfs the Web. As of November 1994, the database contained close to 350,000 separate entries. Searching the database is by keyword, with results returned according to a WAIS scoring system.

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Name	Internet Address	Description
WebMuseum (The)	http://sunsite.unc.edu/louvre/	A collaborative work of visitors. The Museum site includes About the Museum; WebMuseum Partners; What's New; Special Exhibitions; General Exhibitions; and Other Resources.
Web Voyeur (The)	http://www.eskimo.com/%7Eirving/web-voyeur	A list of live videos available on the Web. All sites listed are freely accessible, with no requirement for payment, registration, etc. Still under construction and development.
World Health Organization (The)	http://www.who.ch/	This experimental server of the World Health Organization comprises information on the Erbola virus outbreak; World Health Day; World No-Tobacco Day; press releases and newsletters from WHO; WHO's major programs; international travel and health; Who Statistical Information System (WHOSIS); WHO publications and library; Who e-mail address directories and vacancy notices; EINET Galaxy, Yahoo and Nova-Links; and health-related Web servers.
World Public Access UNIX (The)	gopher://world.std.com	The site includes the Online Book Initiative; Internet and USENET phone books; shops on The World; commercial services via the Internet; book sellers; bulletin boards via the Internet; government information; Internet information and resources; libraries; membership and professional associations; news and weather; nonprofit organizations; other gophers and information servers; periodicals, magazines and journals; USENET newsgroups and mailing list archives; and the University of Minnesota Gopher Server.
Yahoo	http://www.yahoo.com	With over 40,000 entries, the Yahoo Guide is the Net's largest subject index of WWW resources. Aside from its subject listings, Yahoo features a search function and hotlists of "What's Cool" and "What's Popular" at the site.

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INDEX

Academy of Educational Development (The) - 1
Academic Position Network - 1
Access Excellence Network - 1
Administration for Children and Families, U.S. Department of Health and Human Services - 26
Alternative Colleges Network - 1
American Association for Higher Education, Teaching, Learning and Technology Roundtable - 1
American Association for the Advancement of Science Project - 1
American Association of Collegiate Registrars and Admission Officers - 2
American Council on Education - 2
American Educational Research Association - 2
American Library Association - 2
American Memory Historical Collections for the National Digital Library - 26
America's Job Bank - 32
Annenberg/CPB Higher Education Project - 2
Apple Computer Higher Education: The Apple Virtual Campus - 2
Apple Education - 3
Arizona Board of Regents - 3
Ask ERIC Virtual Library - 3
Association for Educational Communications and Technology - 3
Association for Practical and Professional Ethics - 32
Association for Supervision and Curriculum Development - 3
Association of Research Libraries - 3
Boston Book Review (The) - 32
Brookings Institution - 3
Bureau of Labor Statistics, U. S. Department of Labor - 26
California Department of Education - 4
Career Magazine - 32
Carnegie Corporation - 4
CAUSE, Association for Managing and Using Information Resources in Higher Education - 4
Center for Educational Leadership, McGill University - 4
Center for Excellence in Education - 4
Center for Labor Research and Education - 4
Center for Research in Educational Policy - 5
Center for Research on Educational Accountability and Teacher Evaluation - 5
Center for Talent Development (The) - 5
Center for Teaching and Learning (The), Duke University - 5
Center for Telecommunications Research, Columbia University - 5
Center for Women's Studies in Education - 5
Central Intelligence Agency, The World Fact Book - 26
Chicano/Latino Network - 6
Children Now - 6
Children, Youth and Family Education Network - 6
Chreods - 6
Chronicle of Higher Education (The), Academe this Week - 6
CityNet - 33
Cleveland State University Law Library - 7
Cloniara School - 7
Coalition for Networked Information - 7
College Board (The) - 7
Colorado K-12 Internet Gopher Server - 7
Computer as Learning Partner - 7
Computer Professionals for Social Responsibility - 33
Condition of Education, 1994 (The) - 7
Congressional Quarterly Gopher (The) - 26
Conservation Online, Resources for Conservation Professionals - 7
COOMBSQUEST, Australian National University - 8
Cornucopia of Disability Information - 33
Council for the Advancement and Support of Education (The) - 8
Council of the Great City Schools - 33
Counterpoint Publishing's Daily Federal Register - 33
CRESST, National Center for Research on Evaluation Standards and Student Testing - 8
CUNY, Information Resource and Online Academic Degree System - 8
DeweyWeb, University of Michigan - 8
Digest of Education Statistics, 1994 - 8
Directory of WWW.*.EDUServers - 8
Distance Learning Directory - 8
Economic Bulletin Board, Department of Commerce - 26
Economist (The) - 33
Education Alliance for Equity and Excellence (The) - 8
Education Policy Analysis Archives (The) - 9
Educational Forum - 9
Educational Services - 9
Educational Technology Review Center - 34
Educational Testing Service - 9
EDUCOM - 9
Electronic Activist (The) - 34
Electronic Zoo (The) - 34
E-MATH - 9
Empire Internet Schoolhouse - 9
Environmental Education Network - 9
Environmental Protection Agency - 27
ERIC Clearinghouse for Community Colleges - 10
ERIC Clearinghouse for Science, Mathematics, and Environmental Education - 10
ERIC Clearinghouse on Adult, Career and Vocational Education - 10
ERIC Clearinghouse on Assessment and Evaluation, The Catholic University of America - 10
ERIC Clearinghouse on Counseling and Student Services - 10

BEST COPY AVAILABLE

ERIC Clearinghouse on Disabilities and Gifted Education - 10
ERIC Clearinghouse on Educational Management - 10
ERIC Clearinghouse on Elementary and Early Childhood Education - 11
ERIC Clearinghouse on Higher Education - 11
ERIC Clearinghouse on Information and Technology - 11
ERIC Clearinghouse on Languages and Linguistics - 11
ERIC Clearinghouse on Reading, English and Communication Skills - 12
ERIC Clearinghouse on Rural Education and Small Schools, Appalachia Educational Laboratory, Inc. - 12
ERIC Clearinghouse on Social Studies and Social Science Education - 12
ERIC Clearinghouse on Teaching and Teacher Education - 12
ERIC Clearinghouse on Urban Education - 12
FedWorld Information Network - 27
Financial Aid Information - 12
Foundation Center (The) - 34
Foundation for Continuing Education - 13
Franklin Institute Science Museum (The) - 13
FredNet MOO - 13
GENSCOPE - 13
George Lucas Education Foundation (The) - 13
Governmentwide Electronic Messaging Program Management Office - 27
Harvard Graduate School of Education - 13
Higher Education Center for Alcohol and Other Drug Prevention - 14
Higher Education Coordinating Board, Minnesota - 13
IBM ACTS Higher Education Information Server - 14
Illinois State Board of Education - 14
Indiana Department of Education, IDEANET - 14
Indiana Education Policy Center - 14
Information for Teachers - 14
INSPIRE - 15
Instant Access Treasure Chest (The), The Guide to Learning Disabilities and Foreign Language Learning - 15
Institute for the Academic Advancement of Youth (The) - 15
Institute of Electrical and Electronic Engineers, Inc. (The) - 34
Instructional Technology and Training - 15
Instructional Technology Research Online - 15
Internal Revenue Service - 27
International Association for Statistics Education Archive - 15
Internet Public Library - 34
Internet Resources for Institutional Research - 16
Journal of Statistics Education (The) - 16
KIDLINK - 16
LatinoLink - 34
LAW - 16
Learning Research and Development Center, University of Pittsburgh - 16
Library of Congress (The), MARVEL - 27
Long Island Educator (The) - 16
McKinley Internet Directory (The) - 35
Mathematics Archives - 16
Meta Network - 35
Michigan Department of Education - 17
MidLink Magazine - 17
Minority Scholarships and Fellowships - 17
National Academy of Sciences (The) - 17
National Center for Research on Teacher Learning - 17
National Center for State Courts - 35
National Center on Adult Literacy - 17
National Center on Postsecondary Teaching, Learning and Assessment - 18
National Clearinghouse for Alcohol and Drug Abuse - 28
National Clearinghouse for Bilingual Education - 18
National Clearinghouse for Math and Science Education - 18
National Crime Justice Reference Service - 28
National Diffusion Network - 18
National Endowment for the Humanities - 28
National Institute for Literacy - 18
National Museum of Natural History - 28
National Parent Information Network - 18
National Rehabilitation Information Center - 35
National Research Council - 28
National Science Foundation - 28
NETOPEN, Multilingual Directory of Services - 35
NetSchool Project - 18
New Generation Education - 19
New York Metropolitan Reference and Research Library Agency (METRO) - 35
New York Public Library - 19
New York State Archives and Records Administration - 29
New York State Assembly - 29
New York State Court of Appeals - 29
New York State Department of Economic Development - 29
New York State Department of Health - 30
New York State Education and Research Network - 19
New York State Education Department - 19
New York State Library - 19
New York State Office of General Services, State Contracts Database - 30
New York State Senate - 30
North Carolina Department of Public Instruction - 20
North Country Reference and Research Resources Council - 20
Ohio Board of Regents - 20
Ohio Department of Education - 20
Oklahoma State Regents for Higher Education - 20
Online Education, The Electronic University, University of Paisley - 20
Pluribus Unum, Teachers College - 20
Project America - 36
Projections of Education Statistics to 2004 - 20
Public Broadcasting Service - 30
Regional Educational Laboratories, U.S. Department of

Education - 21
Regional Laboratory for Educational Improvement of the Northeast & Islands - 21
Research for Better Schools - 21
Shuttle Atlantis Mission - 36
Science Learning Network - 22
Science World - 21
Scientific Research and Higher Education Center of Ensenada, Mexico - 22
SciLink - 22
Sloan Foundation - 22
Small Business Development Research Network - 36
Smithsonian Institution - 30
Social Security Administration - 30
South Dakota Board of Regents - 22
STAR Schools - 22
Statistical Abstract of the United States, 1994 - 30
StatLib - 36
Student Financial Aid - 22
Substance Abuse and Mental Health Services Administration - 31
Syllabus Web - 36
Teacher Education Information Server - 22
Technology and Information Educational Services - 23
Texas Education Agency - 23
Texas Higher Education Coordinating Board - 23
Tiger Map Service Experimental Browser - 31
Training Registry - 37
UIUC Advanced Information Technologies Group - 37
United States Bureau of the Census - 31
United States Constitution - 31
United States Copyright Office - 31
United States Department of Education - 24
United States Geological Survey - 31
United States House of Representatives - 32
United States of America Home Page - 37
United States Senate - 32
Universities - 24
University of Alaska Board of Regents - 24
University of Puerto Rico, Central Administration - 24
UPRNet - 24
Urban Education National Network - 25
Video Journal of Education (The) - 25
Villanova Center for Information Law and Policy - 37
Virtual Reference Desk (The) - 37
WebCrawler - 37
WebMuseum (The) - 38
Web Voyeur (The) - 38
White House (The) - 32
Wisconsin Department of Public Instruction - 25
World Health Organization (The) - 38
World Public Access UNIX (The) - 38
Yahoo - 38
Youth Indicators, 1993 - 25
120 Years of American Education - 25

GLOSSARY

ARCHIE:	A useful Internet searching tool.
BROWSER:	A software application that recognizes the standards that define the World Wide Web.
FTP:	The File Transfer Protocol (FTP) is the most frequently used service allowing the access and transfer of data in a variety of formats (a cross-platform tool) from one computer to another.
GOPHER:	A menu driven information system providing an organized and user-friendly interface to access information via the Internet.
JUGHEAD:	Another useful Internet searching tool.
TCP/IP:	Transmission Control Protocol/Internet Protocol. A software providing the protocols needed to connect to the Internet.
TELNET:	A protocol allowing Internet users to connect (log) into a remote computer.
URL:	The Uniform Resource Locator (URL) is a system that allows the user to specify the exact location of an Internet site or resource, and the network protocol required to retrieve and interpret the resource. The user should be extremely careful in typing the address as any minor deviation will inhibit the communication with the site.
VERONICA:	Veronica operates as an indexing service for the diversity of menus available in gopherspace.
WEB BROWSER:	A computer program that allows the user to retrieve HTML documents from the Internet, and formats the documents in a format that could be displayed. The most commonly known browsers are Mosaic, Netscape Navigator, Lynx, and Cello.
WIDE-AREA INFORMATION SERVICE (WAIS)	An Internet search tool allowing the user to investigate the contents of stored items and their names.
WWW	The abbreviation commonly used to refer to the World Wide Web, or all the computers connected to the Internet.

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Appendix F: Additional Reading Material

Additional Reading Material

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